NASA

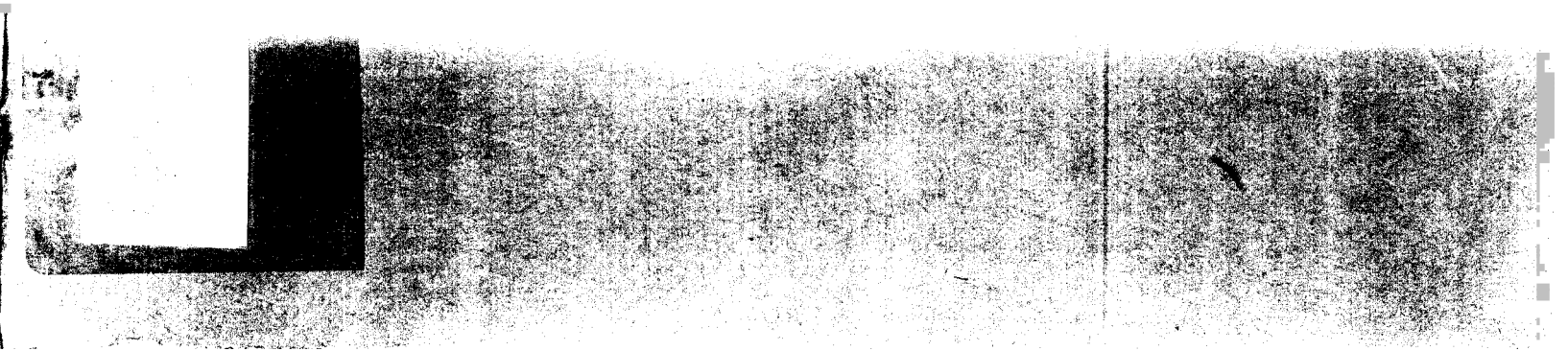
National Aeronautics and
Space Administration

Budget Estimates

FISCAL YEAR 1989

Volume II

Construction of Facilities



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1989 ESTIMATES

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VOLUME II

SUMMARY
INFORMATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

GENERAL STATEMENT

The Construction of Facilities (CoF) appropriation provides contractual services for the repair, rehabilitation and modification of existing facilities, the construction of new facilities; the acquisition of related facility equipment; the design of facilities projects; and advance planning related to future facilities needs.

The funds requested for FY 1989 provide for the continuation of prior year endeavors in meeting the facilities requirements for the Space Flight and Space Station programs; initiation of a structured multi-year effort to restore and modernize NASA's aeronautical research and development facilities; repair, rehabilitation and modification of other facilities to maintain, upgrade and improve the usefulness of the NASA physical plant; minor construction of new facilities, facility planning and design activities, and environmental compliance and restoration.

The projects and amounts in the budget estimates reflect Space Station and Space Flight requirements that are time-sensitive to meet specific program objectives. Other program requirements for 1989 include construction of an auxiliary chiller facility at the Johnson Space Center, modifications to the X-Ray Calibration Facility to support the Advanced X-Ray Astrophysics Facility Program at the Marshall Space Flight Center, modernization of the Space Environment Simulator and modifications for utility reliability at the Goddard Space Flight Center, refurbishment of the 25-Foot Space Simulator at the Jet Propulsion Laboratory, projects to repair, restore and modernize NASA's aeronautical research and development facilities at Ames, Lewis, and Langley Research Centers, and refurbishment of the Electric Power Laboratory at the Lewis Research Center.

The FY 1988 program continues to meet the objectives of preserving and enhancing the capabilities and usefulness of existing facilities and ensuring safe, economical and efficient use of the NASA physical plant. This request continues the necessary rehabilitation and modification program begun in prior years and continues a repair program. The purpose of the repair program is to restore facilities to a condition substantially equivalent to their originally designed capability. The minor construction program continues to provide a means to accomplish smaller facility projects which accommodate changes in technical and institutional requirements. The Environmental Compliance and Restoration Program will ensure that statutory environmental requirements will be met and any necessary remedial action promptly taken.

Funds requested for facility planning and design cover advance planning and design requirements for potential future projects, master planning, facilities studies, engineering reports and studies and the preparation of facility project design drawings and bid specifications.

The budget authority requested for FY 1989 is $285,100,000, with estimated outlays of $178,000,000.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
PROPOSED APPROPRIATION LANGUAGE

CONSTRUCTION OF FACILITIES

For construction, **repair,** rehabilitation **and** modification of facilities, *minor* construction of new facilities **and** additions to existing **facilities, and** for facility planning **and design** not otherwise provided, for **the** National **Aeronautics and Space Administration,** and for tho acquisition or condemnation *of* real property, as **authorized** by law, **[$178,272,000]** ***$285,100,000,*** to remain **available** until **September 30, [1990]** ***1991: Provided,*** That, notwithstanding the limitation on the **availability** *of* **funds** appropriated under this heading by this **appropriations** Act, when any activity has been initiated by the incurrence **of obligations** therefor, tho amount available for ruch activity **shall** remain available until expended, except that **this** provision shall not apply to the amounts appropriated pursuant to the authorization for **repair, rehabilitation** and modification **of facilities,** minor construction **of new** facilities and additions to existing facilities, **and** facility **planning** and design: *Provided further,* **That** no amount **appropriated** pursuant to **this** *or* any other Act may **be** used for the **lease** or **construction** of a new **contractor-funded** facility for exclusive use in support of a contract *or* contracts with the National Aeronautics **and Space Administration under** which **the** Administration would be **required to subetantially amortize through payment or reimbursement such contractor investment, unless an appropriations Act specifies the lease or contract pursuant to which such facilities are to be constructed or leased or such facility is otherwise identified in such Act:** ***Provided further,*** **That the Administrator may authorize such facility lease or construction, if he determines, in consultation with the Committees on Appropriations, that deferral of such action until the enactment of the next appropriations Act would be inconsistent with the interest of the Nation in aeronautical and space activities.** ***(Department of Housing and Urban Development-Independent Agencies Appropriations Act, 1988; additional authorizing legislation to be proposed.)***

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1989 ESTIMATES

SUMMARY OF THE BUDGET PLAN BY LOCATION

LOCATION	Fiscal Year 1987	Fiscal Year 1988	Fiscal Year 1989 Agency Request
	(Thousands of Dollars)		
Space Station Facilities	12,480	...	27,900
Space Flight Facilities	3,300	17,200	34,200
Lyndon B. Johnson Space Center	8,750	...	7,800
George C. Marshall Space Flight Center	...	...	11,400
Goddard Space Flight Center	7,750	8,600	5,900
Jet Propulsion Laboratory	12,000	...	12,000
Aeronautical Facilities Revitalization	...	16,000	63,800
Ames Research Center	9,100	...	...
Dryden Flight Research Facility	7,500	10,500	...
Langley Research Center	11,300	...	...
Lewis Research Center	...	16,300	6,100
Various Locations	21,350	6,400	...
Repair	22,000	24,400	27,000
Rehabilitation and Modification	29,770	30,972	*34,000*
Minor Construction	7,000	8,000	9,000
Facility Planning and Design	17,000	16,000	20,000
Environmental Compliance and Restoration	...	23,900	26,000
Total Plan	169,300	178,272	285,100

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1989 ESTIMATES

SUMMARY OF THE BUDGET PLAN BY COGNIZANT OFFICE

Office	Fiscal Year 1987	Fiscal Year 1988	Fiscal Year 1989 Agency Request
	(Thousands of Dollars)		
Space Station	12,480	...	27,900
Space Flight	12,050	17,200	42,000
Space Science and Applications	19,750	8,600	29,300
Aeronautics and Space Technology	27,900	42,800	69,900
Space Operations	21,350	6,400	...
Management	75,770	103,272	116,000
Total Plan	169,300	178,272	285,100

SUMMARY OF THE BUDGET PLAN BY SUBFUNCTION

Code No.				
253	Space Flight	15,780	17,200	62,100
254	Space Science, Applications, and Technology	16,850	8,600	32,300
255	Supporting Space Activities	117,870	109,672	126,900
(250)	Subtotal, General Science, Space and Technology	150,500	135,472	221,300
402	Air Transportation	18,800	42,800	63,800
	Total Plan	169,300	178,272	285,100

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1989 ESTIMATES
BUDGET PLAN BY LOCATION AND PROJECT

CO	BA	SF	INSTALLATION AND PROJECT	Fiscal Year 1987	Fiscal Year 1988	Fiscal Year 1989 Agency Request	Page No.
				(Thousands of Dollars)			
			SPACE STATION FACILITIES AT VARIOUS LOCATIONS:	12,480	...	27,900	
SS	1	253	Construction of Space Station Processing Facility (KSC)	...	...	15,000	CF 1-1
SS	1	253	Modifications of Process Technology Facility for Space Station (MSFC)	...	...	3,700	CF 1-11
SS	1	253	Construction of Addition for Space Systems Automated Integration and Assembly Facility (JSC)	...	...	9,200	CF 1-17
SS	1	253	Construction of Addition to the Systems Integration and Mockup Laboratory (JSC)	4,300	...	...	
SS	1	253	Construction of Power Systems Facility (LeRC)	6,380	...	...	
SS	1	253	Modifications to Test Stand 300 for Space Station Hydrogen/Oxygen Propulsion Systems Development (MSFC)	1,800	...	...	
			SPACE FLIGHT FACILITIES AT VARIOUS LOCATIONS:	3,300	17,200	34,200	
SF	1	253	Replacement of High Pressure Gas Storage Vessels (NSTL)	...	...	3,500	CF 2-1
SF	1	253	Increase Chiller Capacity, LC-39 Utility Annex (KSC)	...	...	2,300	CF 2-6
SF	1	253	Rehabilitation of PAD A, Launch Complex 39 (KSC)	...	...	4,600	CF 2-13
SF	1	253	Refurbish Atmospheric Reentry Materials and Structures Evaluation Facility (JSC)	...	...	4,900	CF 2-20
SF	1	253	Modifications for Advanced Engine Development, Test Stand 116 (MSFC)	...	...	13,500	CF 2-27
SF	1	253	Modifications to Orbiter Modification and Refurbishment Facility (OMRF) for Safing and Deservicing (KSC)	...	...	2,800	CF 2-35
SF	1	253	Construction of National Resource Protection (Various Locations)	...	...	2,600	CF 2-42
SF	1	253	Construction of LC-39 Operations Support Building (KSC)	...	17,200	...	
SF	1	253	Construction of Addition to Orbiter Processing Facility Annex (KSC)	3,300	...	...	

CO	BA	SF	INSTALLATION AND PROJECT	Fiscal Year 1987	Fiscal Year 1988	Fiscal Year 1989 Agency Request	Page No.
				(Thousands of Dollars)			
			JOHNSON SPACE CENTER	8,750	...	7,800	
SF	7	255	Construction of Auxiliary Chiller Facility	...	...	7,800	CF 3-1
SF	7	255	Construction of Central Computing Facility	8,750	...	...	
			MARSHALL SPACE FLIGHT CENTER	...	...	11,400	
SSA	2	254	Modifications to the X-Ray Calibration Facility (XRCF)	...	...	11,400	CF 4-1
			GODDARD SPACE FLIGHT CENTER	7,750	8,600	5,900	
SSA	2	254	Modernization of Space Environment Simulator	...	...	2,800	CF 5-1
SSA	7	255	Modifications for Utility Reliability	...	...	3,100	CF 5-9
SSA	2	254	Construction of Spacecraft Systems Development and Integration Facility	7,750	8,600	...	
			JET PROPULSION LABORATORY	12,000	...	12,000	
SSA	2	254	Refurbishment of 25-Foot Space Simulator	...	...	12,000	CF 6-1
SSA	7	255	Construction of Engineering Support Building	9,500	...	...	
SSA	7	255	Modification of Uninterruptible Power System in Space Flight Operations Facility	2,500	...	...	
			AERONAUTICAL FACILITIES REVITALIZATION AT VARIOUS LOCATIONS	...	16,000	63,800	
AST	5	402	Repair and Modernization of the 12-Foot Pressure Wind Tunnel (ARC)	...	16,000	36,500	CF 7-1
AST	5	402	Rehabilitation and Modifications to 10X10 Supersonic Wind Tunnel (LeRC)	...	...	14,500	CF 7-9
AST	5	402	Refurbishment of Hypersonic Facilities Complex (LaRC)	...	...	12,800	CF 7-17

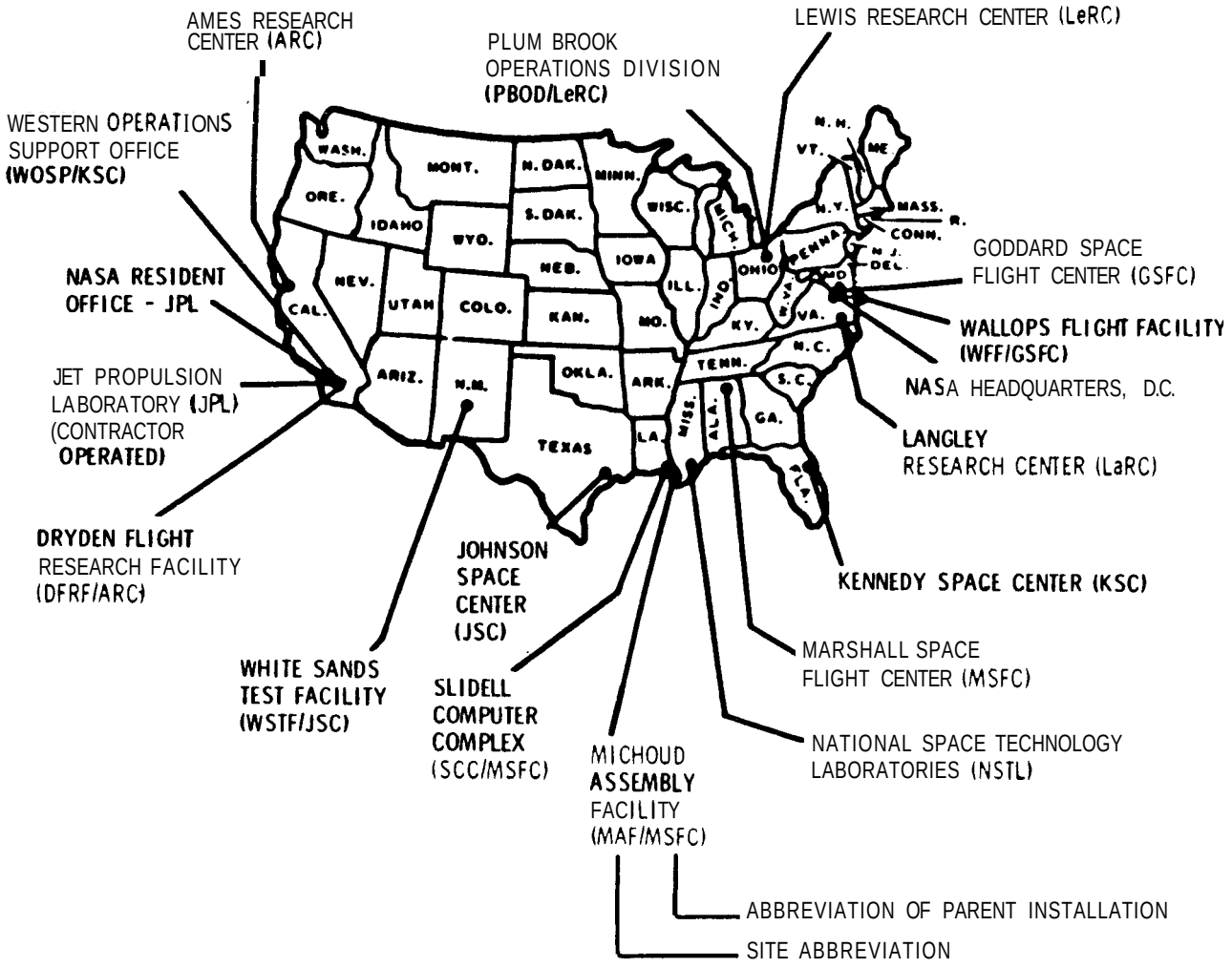
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CONSTRUCTION OF FACILITIES
FISCAL YEAR *1989* ESTIMATES
BUDGET PLAN BY LOCATION AND PROJECT

CO BA SF	INSTALLATION AND PROJECT	Fiscal Year *1987*	Fiscal Year *1988*	Fiscal Year *1989* Agency Request	Page No.
	AHES RESEARCH CENTER	*9,100*	---	---	
AST *4 254*	Construction of Human Performance Research Laboratory	*9,100*	---	---	
	DRYDEN FLIGHT RESEARCH FACILITY	*7,500*	*10,500*	---	
AST *5 402*	Construction of Integrated Test Facility	*7,500*	*10,500*	---	
	LANGLEY RESEARCH CENTER	*11,300*	---	---	
AST *5 402*	Construction of Addition for Non-Destructive Evaluation Research Facility	*1,900*	---	---	
AST *5 402*	Modifications to 8-Foot High Temperature Tunnel	*9,400*	---	---	
	LEWIS RESEARCH CENTER	0	16,300	*6,100*	
AST *4 254*	Refurbishment of Electric Pover Laboratory	---	---	*6,100*	CF *8-1*
AST *5 402*	Construction of Addition to the Research Analysis Center.	---	9,800	---	
AST *5 402*	Modifications for Fan/Compressor Research, Engine Research Building	---	*6,500*	---	
	VARIOUS LOCATIONS	*21,350*	6,400	---	
SO *7 255*	Construction of Communications Development Antenna, Goldstone, CA (JPL)	---	*6,400*	---	
SO *7 255*	Construction of the Second Tracking and Data Relay Satellite System Ground Terminal Facility in New Mexico.	*21,350*	---	---	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1989 ESTIMATES
BUDGET PLAN BY LOCATION AND PROJECT

CO BA SF	INSTALLATION AND PROJECT	Fiscal Year 1987	Fiscal Year 1988	Fiscal Year 1989 Agency Request	Page No.
		(Thousands of Dollars)			
MGT 7 255	REPAIR OF FACILITIES AT VARIOUS LOCATIONS, NOT IN EXCESS OF $750,000 PER PROJECT...	22,000	24,400	27,000	CF 9-1
MGT 7 255	REHABILITATION AND MODIFICATION OF FACILITIES AT VARIOUS LOCATIONS NOT IN EXCESS OF $750,000 PER PROJECT.....	29,770	30,972	34,000	CF 10-1
MGT 7 255	MINOR CONSTRUCTION OF NEW FACILITIES AND ADDITIONS TO EXISTING FACILITIES AT VARIOUS LOCATIONS, NOT IN EXCESS OF $500,000 PER PROJECT....	7,000	8,000	9,000	CF 11-1
MGT 7 255	FACILITY PLANNING AND DESIGN.....	17,000	16,000	20,000	CF 12-1
	SUBTOTAL, CONSTRUCTION.....	169,300	154,372	259,100	
WGT 7 255	ENVIRONMENTAL COMPLIANCE AND RESTORATION PROGRAM..	--	23,900	26,000	CF 13-1
	TOTAL, CONSTRUCTION OF FACILITIES.....	169,300	178,272	285,100	

LOCATION OF MAJOR AND COMPONENT INSTALLATIONS



RECORDED VALUE OF CAPITAL TYPE PROPERTY
IN-HOUSE AND CONTRACTOR-HELD
AS OF SEPTEMBER 30, 1987
(DOLLARS IN THOUSANDS)
REAL PROPERTY

REPORTING INSTALLATION	LAND	BUILDING	OTHER STRUCTURES AND FACILITIES	LEASEHOLD IMPROVEMENTS	TOTAL	FIXED ASSETS EQUIPMENT	IN PROGRESS	GRAND TOTAL
AMES RESEARCH CENTER	2929	357016	27353	0	387298	340456	187008	914762
ARC MOFFETT FIELD, CA	2928	333244	12446	0	348618	240285	182297	771180
DRYDEN FLIGHT FACILITY EDWARDS, CA.	0	23076	14560	0	37636	77669	4711	120016
VARIOUS LOCATIONS (a)	1	696	347	0	1044	22522	0	23566
GODDARD SPACE FLIGHT CENTER	2857	167649	111541	0	282047	427030	44449	753526
GSFC - GREENBELT, MD.	1362	110791	19524	0	131677	222219	34344	388240
TRACKING STATIONS NETWORK	5	11349	24734	0	36088	125499	3556	165143
WFF - WALLOPS ISLAND, VA	1490	41544	67282	0	110316	58427	6549	175292
VARIOUS LOCATIONS (a)	0	3965	1	0	3966	20885	0	24851
JET PROPULSION LABORATORY	1188	121924	89535	1894	214541	383811	72805	671157
JPL - PASADENA, CA	1188	109591	17475	1892	130146	313516	72805	516467
DEEP SPACE NETWORK	0	12333	72060	2	84395	70295	0	154690
JOHNSON SPACE CENTER	10889	221976	78839	105	311809	449727	4824	766360
JSC - HOUSTON, TX	7319	182118	48452	0	237889	269186	4824	511899
WHITE SANDS TEST FACILITY LOS CRUCES, NM.	0	9953	24816	105	34874	24507	0	59381
VARIOUS LOCATIONS (a)	3570	29905	5571	0	39046	156034	0	195080
KENNEDY SPACE CENTER	71345	508917	527756	0	1108018	708750	38007	1854775
KSC - CAPE CANAVERAL, FL.	71345	508917	527756	0	1108018	138911	38007	1284936
WESTERN TEST RANGE, LOMPAC, CA.	0	0	0	0	0	122156	0	122156
VARIOUS LOCATIONS (a)	0	0	0	0	0	447683	0	447683
LANGLEY RESEARCH CENTER	156	171213	338207	0	509576	200700	53600	763876
LARC - HAMPTON, VA.	156	171213	338207	0	509576	187251	53600	750427
VARIOUS LOCATIONS (a)	0	0	0	0	0	13449	0	13449
LEWIS RESEARCH CENTER	2621	235022	87417	136	325196	150367	37947	513510
LERC - CLEVELAND, OH	316	158615	68355	136	227422	128292	37947	393661
PLUMBROOK, SANDUSKY, OH.	2305	76407	19062	0	97774	5293	0	103067
VARIOUS LOCATIONS (a)	0	0	0	0	0	16782	0	16782
MARSHALL SPACE FLIGHT CENTER	7171	288168	151813	0	447152	465347	973	913472
MSFC - HUNTSVILLE, AL.	0	133842	68973	0	202815	265015	973	468803
MICHOUD ASSEMBLY FACLITY, AL.	7102	144273	69765	0	221140	71545	0	292685
SLIDELL COMPUTER COMPLEX, AL.	69	5225	2758	0	8052	8608	0	16660
VARIOUS LOCATIONS (a)	0	4828	10317	0	15145	120179	0	135324
NATIONAL SPACE TECH. LABS.	18061	90094	194635	0	302790	27719	0	330509
NSTL - NSTL STATION, MS.	18061	90094	194635	0	302790	27719	0	330509
VARIOUS LOCATIONS (a)	0	0	0	0	0	0	0	0
NASA HEADQUARTERS	0	0	0	0	0	13541	0	13541
NASA - HQS., WASH., D.C.	0	0	0	0	0	10177	0	10177
VARIOUS LOCATIONS (a)	0	0	0	0	0	3364	0	3364
AGENCY TOTAL	117217	2161979	1607096	2135	3888427	3167448	439613	7495488

SUM 10

JUSTIFICATION
BY LOCATION

SPACE **STATION**
FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

SPACE STATION FACILITIES

	Amount	Page No.
Office of Space Station:		
Construction of Space Station Processing Facility, Kennedy Space Center.	15,000,000	CF 1-1
Modifications of Process Technology Facility for Space Station, Marshall Space Flight Center	3,700,000	CF 1-11
Construction of Addition for Space Systems Automated Integration and Assembly Facility, Johnson Space Center	9,200,000	CF 1-17
Total	27,900,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Construction of Space Station Processing Facility

INSTALLATION: John F. Kennedy Space Center

FY 1989 CoF Estimate: $15,000,000

LOCATION OF PROJECT: Merritt Island, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Station

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding....	$4,920,000	---	$4,920,000
Capitalized investment.....	---	---	---
Total.....	$4,920,000	---	$4,920,000

SUMMARY PURPOSE AND SCOPE:

This project provides the initial increment of construction of the Space Station Processing Facility (SSPF) for the prelaunch and post-landing nonhazardous processing of the various Space Station program elements at the Kennedy Space Center. Follow-on increments to complete the facility are planned for FY 1990 and FY 1991.

PROJECT JUSTIFICATION:

Prelaunch processing is necessary to accomplish post shipment inspection and verification of Space Station elements, to ensure that these elements are properly configured for launch, to verify element-bo-element interfaces, to perform final prelaunch servicing, and to verify on the ground, to the extent practicable, the capability of the elements and systems to function as planned in orbit. Unlike payloads/experiments aboard short duration Space Shuttle missions, Space Station elements will be in orbit for extended periods and cannot be easily or inexpensively returned to Earth for correction of system problems or malfunctions. Ground processing of Space Station elements, therefore, is critical to achieving the program objectives.

Processing of elements/payloads will begin with their delivery and offloading at KSC. Elements are outfitted and assembled to the extent practicable before delivery to KSC. However, at KSC, final assembly, servicing and verification will be accomplished, and each outfitted element will be subsequently configured and integrated for launch. The final processing operation in this facility will be to install the element in the KSC Shuttle payload canister for transportation to the launch pad and insertion into the Orbiter's cargo bay for launch. The need for processing will continue during the operational phase of the Space Station, as certain elements will be regularly returned from orbit for refurbishment, retrofitting, and resupply, such as the U.S. and international logistic modules.

After extensive studies and analysis of the Space Station processing requirements, it was determined that the most cost-effective and efficient manner to provide nonhazardous processing of Space Station elements and their experiments was to build a new facility. Use of the existing Operations and Checkout Building was carefully studied but was determined not suitable due to its configuration and continuing requirement for Spacelab and other programs.

The SSPF has been sized to support the following nonhazardous processing during Space Station assembly and operational phases:

1. Initial components of the Space Station--final assembly, servicing, final tests and closeout.
2. Logistics and Resupply Operations--logistic module loading and unloading, material handling and staging, processing and storage (minimum payload logistics associated with Space Station logistic module payload resupply only).
3. Payload Operations--off-line lab, minimal logistics, staging, storage, prelaunch integration and post-landing deintegration areas.

Location of this facility (Figure 2) close to the existing Operations and Checkout Building will provide the opportunity for joint use of some specialist checkout personnel.

IMPACT OF DELAY:

Delay of this FY 1989 CoF project will delay launch of Space Station elements. Processing activities will be "first time" events which have historically resisted timeline compression and delay of this project will result in subsequent slippage of Space Station operations.

PROJECT DESCRIPTION:

The Space Station Processing Facility (Figure 3) will enclose a total gross area of approximately 297,000 square feet and house a permanent staff of over 900 civil service, contractor, user, and international personnel. Highly specialized areas will include approximately 73,000 square feet of high bay and intermediate bay floor space for parallel processing of eight Space Station (SS) elements in a class 100K clean, controlled environment. An approximately 4,000-square-foot airlock (100K clean) will provide high bay access.

The high bay will support module/element processing and canister/strongback operations and the intermediate bay will provide rack and experiment processing areas. The processing areas will be provided with compressed air and vacuum systems, gaseous storage and distribution systems (GN_2 and GH_e), gaseous vent system for GN_2, and GH_e, and an UV/IR fire detection system.

The off-line support area will contain approximately 220,000 square feet of operational area (Figures 4 and 5). Some of the key areas within the support area include 13,000 square feet for SS support; 11,500 square feet for customer support; 9,500 square feet for international support; and areas for off-line labs and experiment, payload, and rack testing. The remaining space includes operations support areas for schedule and quality control (QC) rooms, shop supervision, documentation and control room, laboratories, and office space. Also included are various common support areas such as mechanical/electrical equipment rooms, electrical communication rooms, cafeteria, rest rooms, elevators, stairwells, and corridors.

Site development and utilities, building foundations and primary structural steel framing will be completed in the first increment of construction. The first increment will also include procurement of long lead mechanical equipment and overhead cranes. Site development will include construction of storm and sanitary sewer systems, GN_2 mains, industrial, and potable water lines, and access roads and parking areas. Electrical utilities will include a unit substation and ductbanks with power and communications cables. The second increment (FY 1990) will provide the building roof, exterior walls, floors, and basic outfitting of the high bay and intermediate bay areas. The third increment (FY 1991) of construction will complete the outfitting of the facility including mechanical and electrical distribution systems, architectural systems, and final landscaping and parking. Emphasis will be placed on specialized areas to ensure their early completion and activation.

PROJECT COST ESTIMATE:

The basis of this cost estimate is the facility PER.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---		15,000,000
Site development				1,942,000
Clear, grub and demuck site	Acres	27	6,529.59	(178,000)
Fill and grading	CY	172,000	4.40	(757,000)
Access roads and parking area	SY	33,160	26.00	(862,000)
Finish grading, sodding, landscaping	LS	---	---	(145,000)
Gaseous Nitrogen main	LF	2,100	190.48	400,000
Water, storm, and sanitary sewer systems	LS	---	---	710,000
Electrical	---	---	---	2,908,000
Unit substation 2500 KVA	EA	I	288,000	(288,000)
Power ductbank	LF	5,400	69.44	(375,000)
Communications ductbank	LF	5,500	130.55	(718,000)
500 MCM 15 KV cable	LF	33,000	18.24	(602,000)
Miscellaneous exterior electrical equipment	LS	---	---	(925,000)
Building Foudations				4,200,000
Formwork	SF	100,400	7.11	(714,000)
Reinforcing steel	LB	1,250,000	1.18	(1,470,000)
Concrete footings, tunnels and slabs	CY	10,500	192.00	(2,016,000)
Structural steel framing (heavy section members)	LB	2,245,600	1.71	3,840,000
Mechanical (long lead items, i.e., chillers)	LS	---	---	1,000,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	--	--	--	---
Total				$15,000,000

NOTE: This cost estimate provides the FY 1989 initial increment of the total facility. The total cost to complete the project is estimated to be approximately $68,700,000.

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Perspective
Figure 4 - Plan View - First Floor
Figure 5 - Plan View - Second Floor

OTHER EQUIPMENT SUMMARY:

Certain noncollateral equipment to be funded from R&D resources and estimated to cost $298 million will be required to support initial SSPF operations.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

To complete this project, a second increment will be included in the FY 1990 budget request for approximately $31 million and a third increment in the FY 1991 budget for $22.7 million.

JOHN F KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
CONSTRUCTION OF SPACE STATION PROCESSING FACILITY

LOCATION PLAN

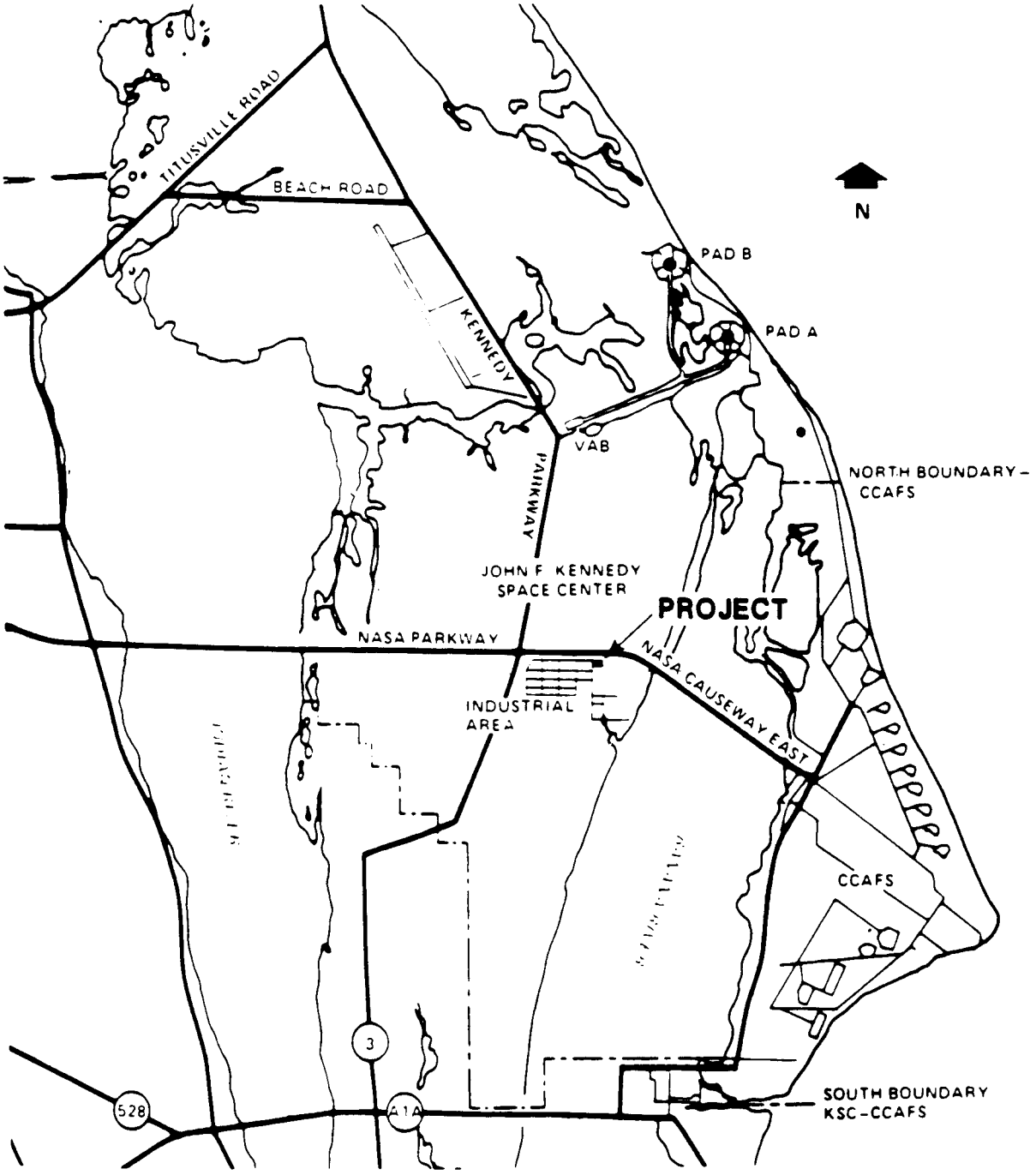


FIGURE 1

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
CONSTRUCTION OF SPACE STATION PROCESSING FACILITY

SITE PLAN

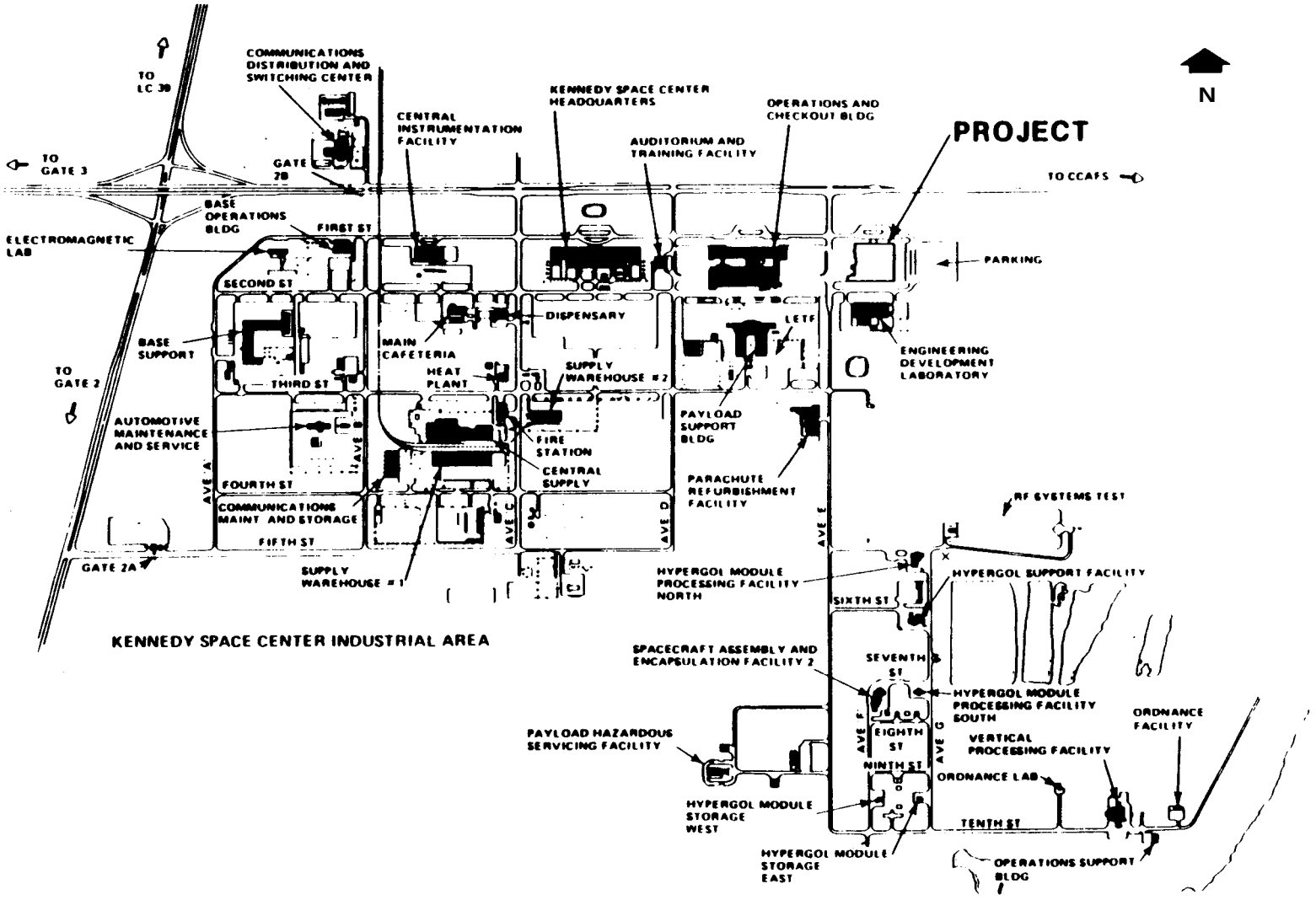


FIGURE 2

JOHN F KENNEDV SPACE CENTER
FISCAL VEAR 1989 ESTIMATES
CONSTRUCTION OF SPACE STATION PROCESSING FACILITY

PERSPECTIVE

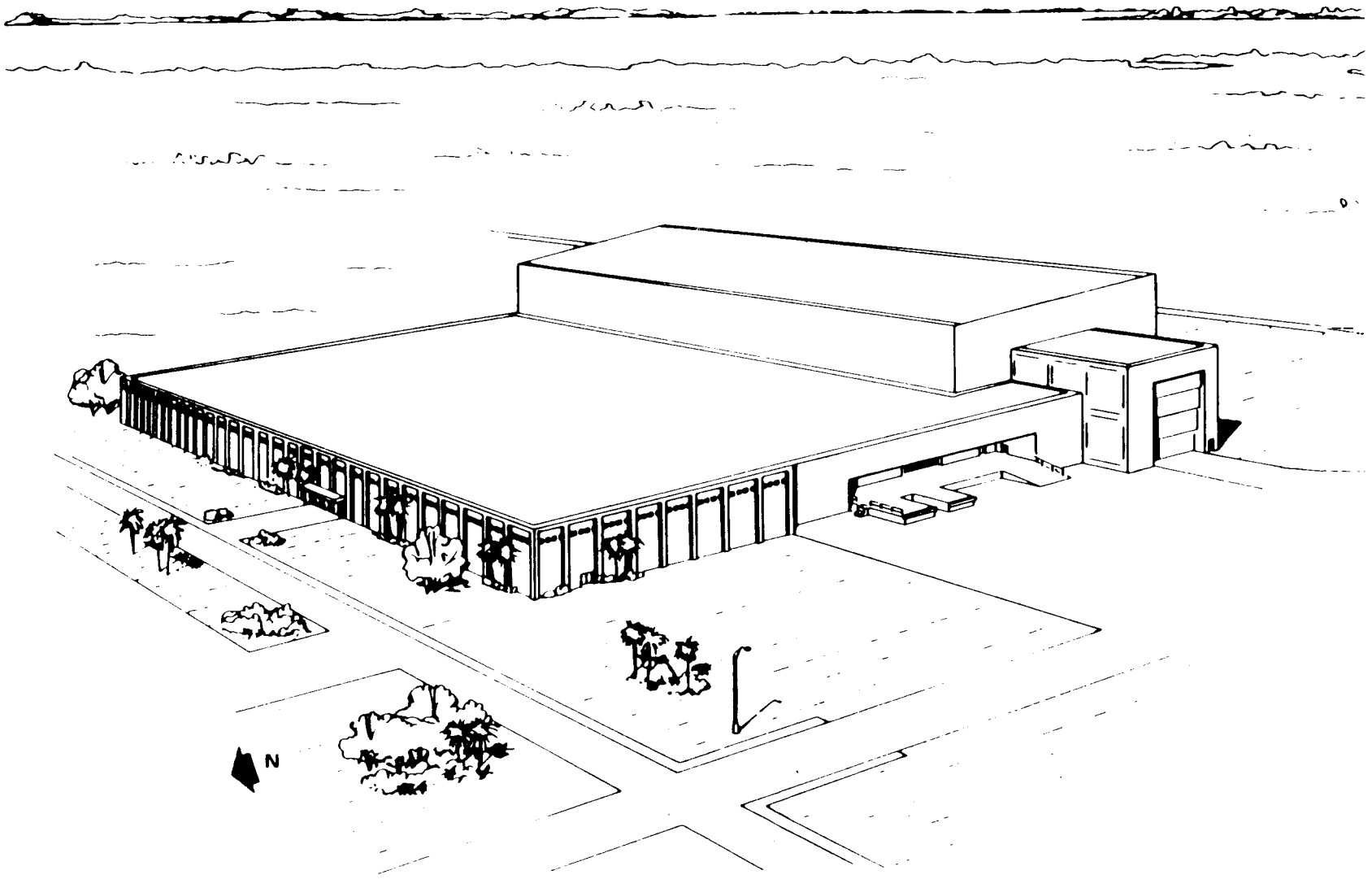


FIGURE 3

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1'989ESTIMATES
CONSTRUCTION OF SPACE STATION PROCESSING FACILITY

PLAN VIEW– FIRST FLOOR

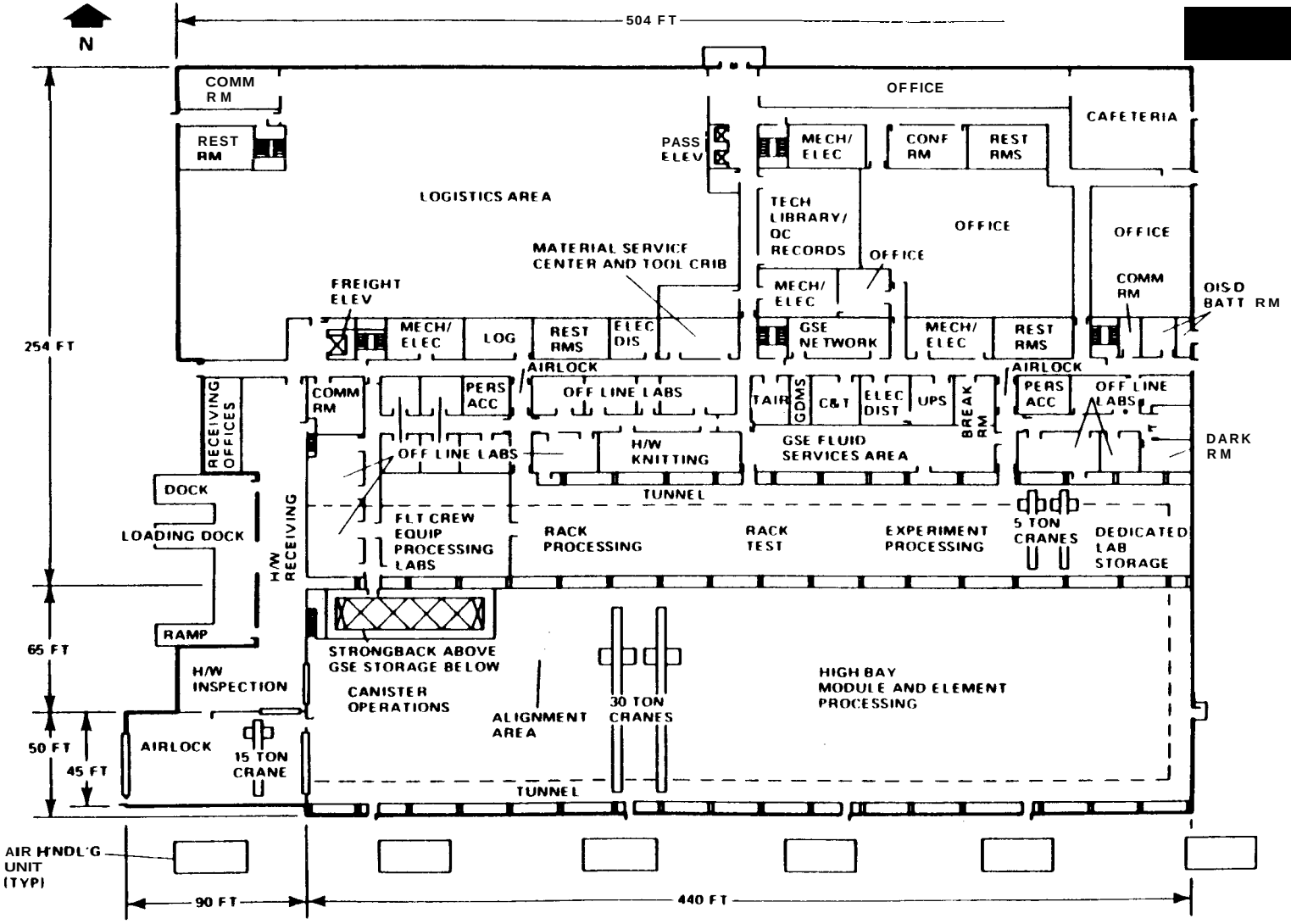


FIGURE 4

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
CONSTRUCTION OF SPACE STATION PROCESSING FACILITY

PLAN VIEW–SECOND FLOOR

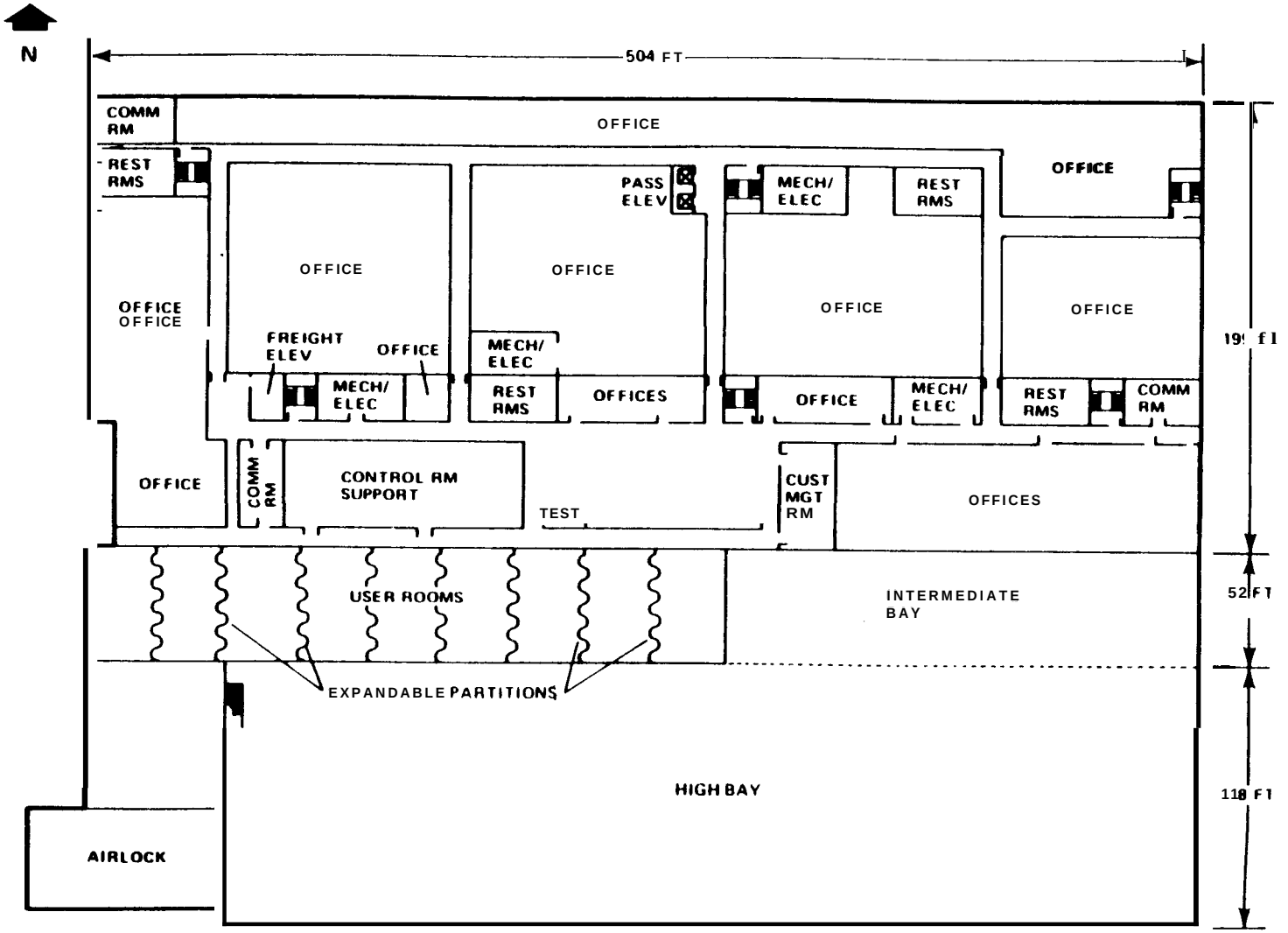


FIGURE 5

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Modifications of Process Technology Facility for Space Station

INSTALLATION: George C. Marshall Space Flight Center

FY 1989 CoF Estimate: $3,700,000

LOCATION OF PROJECT: Marshall Space Flight Center, Madison County, Alabama

COGNIZANT HEADQUARTERS OFFICE: Office of Space Station

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	$280,000	---	$ 280,000
Capitalized Investment.....	---	$4,725,799	4,725,799
Total.....	$280,000	$4,725,799	$5,005,799

SUMMARY PURPOSE AND SCOPE:

This project provides for modification of the Process Technology Facility, Building 4707, for the development of new productivity techniques for Space Station common module fabrication and on-orbit repair techniques. The manned Space Station is planned to remain in orbit for many years and on-orbit repair to damaged hardware will be mandatory for safe habitation. This requires the development of special equipment, tools, materials, and techniques in a simulated vacuum environment to measure the effectiveness of each application for space utilization. A 10-foot by 15-foot working diameter walk-in vacuum chamber, robotic water jet, and composite test component areas will be provided for development and testing of potential space assembly processing and repair activities.

PROJECT JUSTIFICATION:

The manned Space Station is being developed to remain in orbit for approximately 20 years and will require on-orbit repair of damaged hardware. The ability to conduct on-orbit repairs to the Space Station modules as they sustain structural damage or require refurbishment of sealants and surface coatings enhances the longevity and successful operation of the Space Station. Development of the required special repair equipment must include testing in a simulated vacuum environment. Robotized electron beam welding, cutting, soldering, and metal spray coating will be developed and demonstrated. Means of managing debris generated by this process will be studied, with efficiency, reliability and compactness of the repair equipment optimized.

The Space Station, with twice the volume of Skylab and more than 1,000 linear feet of seal application, has a specified leak rate of 5.0 lbs/day versus 22.5 calculated for Skylab, given the same pressure. Accordingly, initial priority will be placed on verification of seal concepts and leak rate. Outgassing characteristics will be determined.

The vacuum chamber is also needed to develop on-orbit bonding and sealing techniques including sealants, adhesives, and coatings for Space Station module repair and refurbishment work. Candidate materials will be tested for outgassing, flammability, toxicity, bonding strength, and sealing efficiency. A laser will be used for the development of ground operations and on-orbit applications including welding and cutting. Work will also include precision alignment of large structures, non-destructive testing, and leak detection. The water knife laboratory will provide the capability for development of ground manufacturing processes with computerized robotic high-pressure water jet cutting of high strength metals and advanced composites to reduce the weight of space structures and launch vehicles.

IMPACT OF DELAY:

Delay of the project will mean that new productivity techniques will not be accomplished in time to support the development of required special equipment needed for the fabrication of the Space Station and could affect the longevity and safety of Space Station operations.

PROJECT DESCRIPTION:

This project modifies and upgrades the Process Technology Facility, Building 4707 (Figure 1). Work includes the modification of approximately 4,000 square feet of space with the installation of a 10-foot by 15-foot-working diameter Space Environment Vacuum Chamber (Figure 2), a clean room area of 1,500 square feet, control room, and instrumentation. This includes the modification of 2,150 square feet of space for cryo pumps and related mechanical equipment. The thermal shrouds in the vacuum chamber and cryo pumps will be cooled with

LN_2 supplied from a 13,500 gallon GFE LN_2 dewar. Work also includes an addition to the building of 1,460 square feet of steel frame and roof construction for a robotic water jet laboratory and modification of 1,330 square feet for a composite test component preparation cell. Building modifications will include partitions, lighting, electrical power, air-conditioning, and mechanical equipment for related laboratories and shops.

PROJECT COST ESTIMATE:

This cost estimate is based on a 60 percent design submission.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition..	---	---	---	---
Construction	---	---	---	$3,700,000
Space environment vacuum chamber (10-foot by 15-foot working diameter)	LS	---	---	$2,750,000
Clean room	SF	1,500	138.67	208,000
Mechanical equipment room	SF	2,150	89.30	192,000
Robotic water jet laboratory	SF	1,460	136.99	200,000
Composite test component preparation laboratoy	SF	1,330	187.97	250,000
Building modifications	LS	---	---	100,000
Equipment	---	---	---	---
Fallout shelter (not feasible)	---	---	---	---
Total				$3,700,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Space Environment Vacuum Chamber

OTHER EQUIPMENT SUMMARY:

Equipment to be funded with R&D resources will consist of a 10 KW laser welding and heat-treating system, 10-foot by 8-foot diameter auto clave, artificial intelligence system, and microvax computer at an estimated cost of $2,700,000.

FUTURE CoF FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF resources are required to complete the present scope of this project, however, additional modifications to the Process Technology Facility may be required to support additional Space Station requirements.

MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1989 ESTIMATES
MODIFICATIONS OF PROCESS TECHNOLOGY FACILITY FOR SPACE STATION

LOCATION PLAN

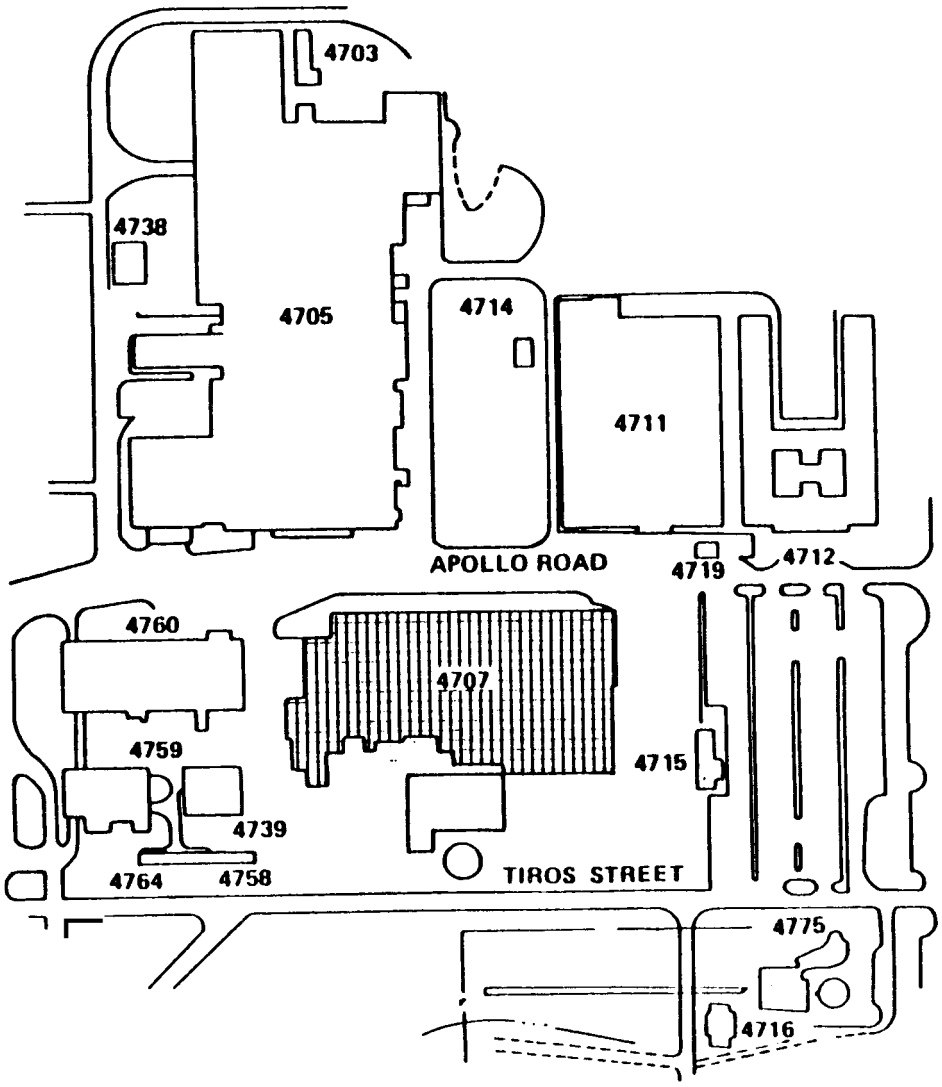


FIGURE 1

MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1989 ESTIMATES
MODIFICATIONS OF PROCESS TECHNOLOGY FACILITY FOR SPACE STATION

SPACE ENVIRONMENT VACUUM CHAMBER

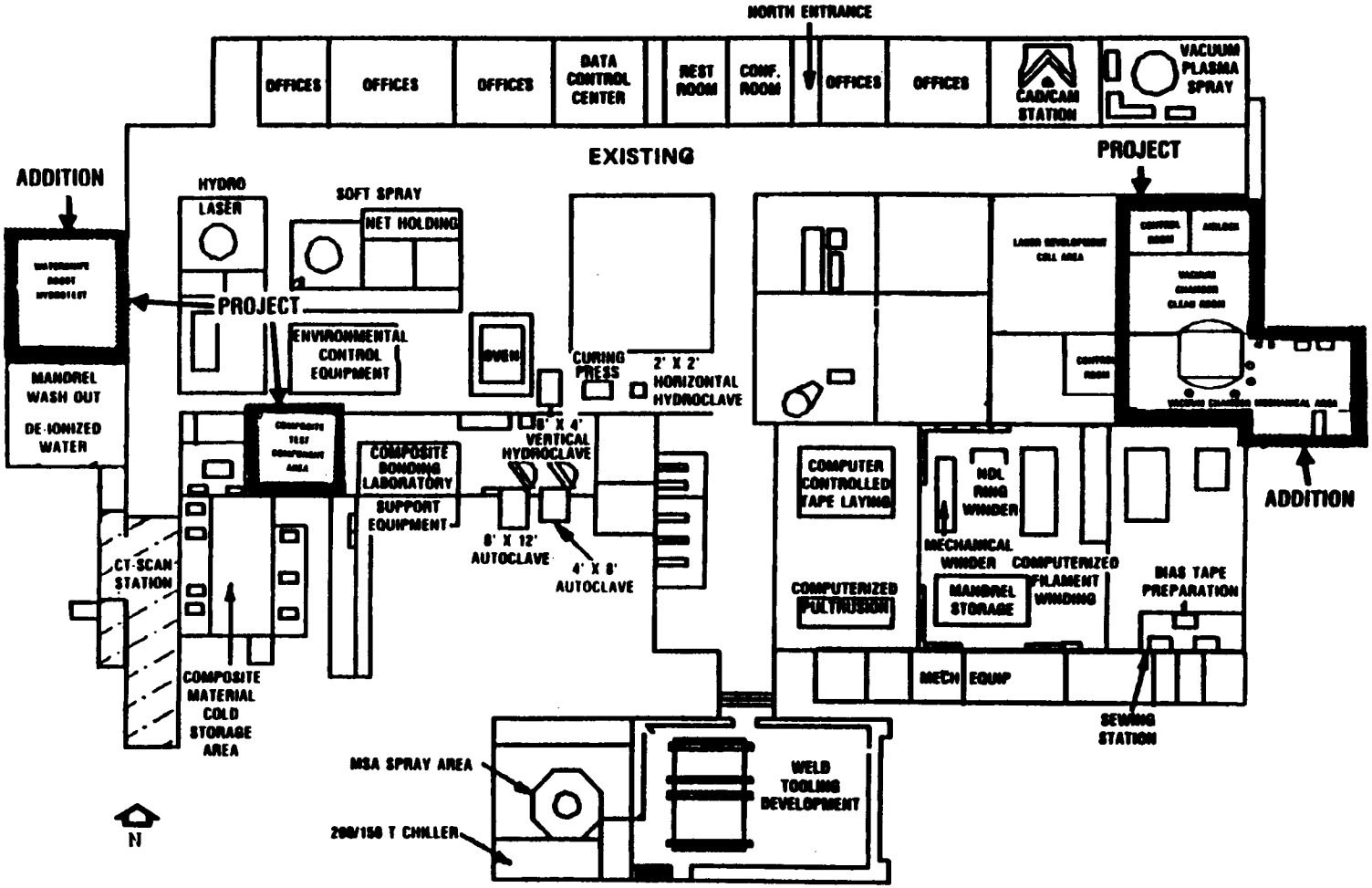


FIGURE 2

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Construction of Addition for Space Systems Automated Integration and Assembly Facility

INSTALLATION: Lyndon B. Johnson Space Center

FY 1989 CoF Estimate: $9,200,000

LOCATION OF PROJECT: Houston, Harris County, Texas

COGNIZANT HEADQUARTERS OFFICE: Office of Space Station

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding	$790,000	---	$ 790,000
Capitalized Investment	---	$5,300,525	5,300,525
Total	$790,000	$5,300,525	$6,090,525

SUMMARY PURPOSE AND SCOPE:

This project provides for construction of an addition to the east end of the Systems Integration and Mockup Laboratory of Building 9 to support development, testing, and flight qualification of integrated component assembly/attachment hardware and other mechanisms for the Space Station. This 47,000-square-foot addition will accommodate simulators, associated support equipment, and personnel used in simulation testing of manual and automated construction techniques and hardware. This project also includes approximately 4,600 square

feet of new air-bearing surface in an existing portion of the building, fire detection and suppression systems, utility tunnel tie-in, bridge crane extension, and paved parking.

PROJECT JUSTIFICATION:

This project provides an area for high-fidelity dynamics simulation testing of manual and automated construction techniques and hardware, component attachment methods, and verification/inspection techniques for on-orbit Space Station structural assembly tasks and similar applications. The high-bay addition will provide required space for a large stationary six-degree-of-freedom simulator, two portable six-degree-of-freedom simulators, a 40- by 40-foot air-bearing floor, and a static test area for various Space Station structures, components, and test fixtures. The three-story laboratory addition is required for a technician work and staging area, test and applications computing support, techniques development laboratories, transient engineering support space, and mechanical equipment associated with the total project. By being added to the established systems integration and mockup area supporting the Space Shuttle, the new area will benefit from shared accessibility, experience, techniques, support personnel, and special facilities. Enlargement of the existing air-bearing floor is required to accommodate full-scale dynamics tests utilizing the Shuttle and Space Station remote manipulator systems. Accomplishment of JSC's responsibilities for engineering and integrated ground verification prior to flight requires these facility capabilities be provided. This building addition is the most cost-effective means for meeting these requirements.

IMPACT OF DELAY:

Existing facilities are inadequate to support integrated Space Station high-fidelity dynamics simulation testing. If the project is not approved, JSC will not be able to meet its responsibilities for Space Station systems engineering and integration activities for proof-of-concept evaluation and end-to-end certification testing.

PROJECT DESCRIPTION:

This project provides for construction of a 47,000-square-foot addition to the east end of the Systems Integration and Mockup Laboratory of Building 9. The addition consists of a 21,000-square-foot high-bay area and a 26,000-square-foot three-story laboratory support area. The project also provides for increasing the existing air-bearing surface area in the Systems Integration and Mockup Laboratory by 3,000 square feet and providing 1,600 square feet of air-bearing surface in the new high-bay area. Additionally, the project includes extending the existing high-bay bridge crane; installing an elevator in the laboratory support area;

connection to the JSC utility tunnel system and utility control system; and installation of fire detection and suppression systems, electrical power, and air-conditioning. A paved parking lot for approximately 60 vehicles also will be provided to support added building personnel and replace parking spaces lost by extending the building.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition...	---	---	---	---
Construction	---	---	---	$9,200,000
Utilities, Utility Relocation, Landscaping, Tunnel Extension, Paving, Sidewalks, and Parking Lot	LS	---	---	568,000
Building High-Bay Addition:				
Architectural	SF	21,000	28.33	595,000
Structural	SF	21,000	87.62	1,840,000
Mechanical	SF	21,000	25.57	537,000
Electrical	SF	21,000	10.95	230,000
Office and Laboratory Addition:				
Architectural	SF	26,000	57.23	1,488,000
Structural	SF	26,000		
Mechanical	SF	26,000	57.23	1,488,000
Electrical	SF	26,000	47.19	1,227,000
Air-Bearing Floor	SF	4,600	144.35	664,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				$9,200,000

LIST OF RELATED GRAPHICS:

Figure 1 - Project Location
Figure 2 - Building Perspective
Figure 3 - Concept Layout

OTHER EQUIPMENT SUMMARY:

Noncollateral equipment such as a six-degree-of-freedom motion simulator, computers and miscellaneous test equipment estimated to cost $2,500,000, will be provided from R&D resources.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding will be required to complete this project.

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
CONSTRUCTION OF ADDITION FOR SPACE SYSTEMS
AUTOMATED INTEGRATION AND ASSEMBLY FACILITY

LOCATION PLAN

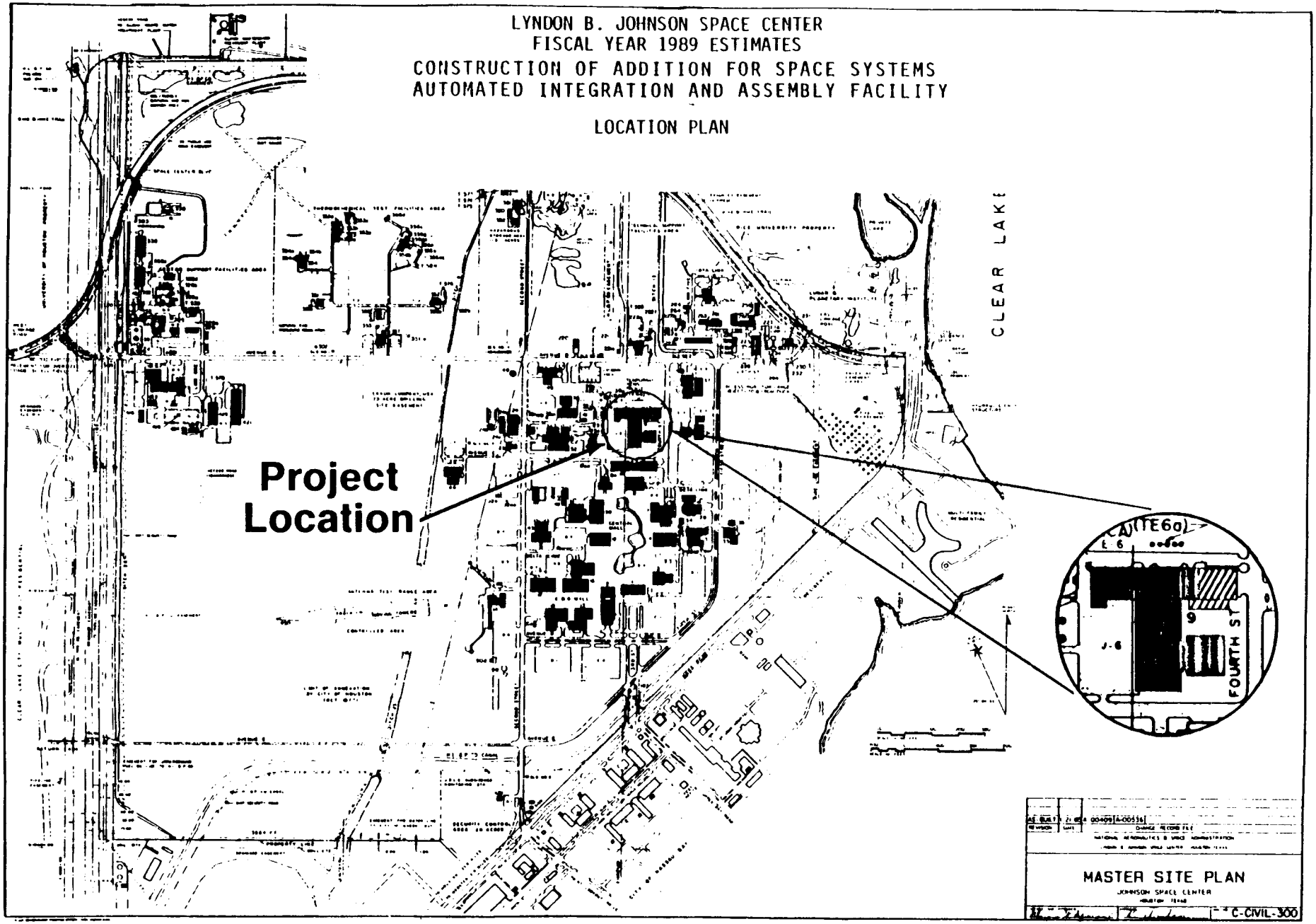
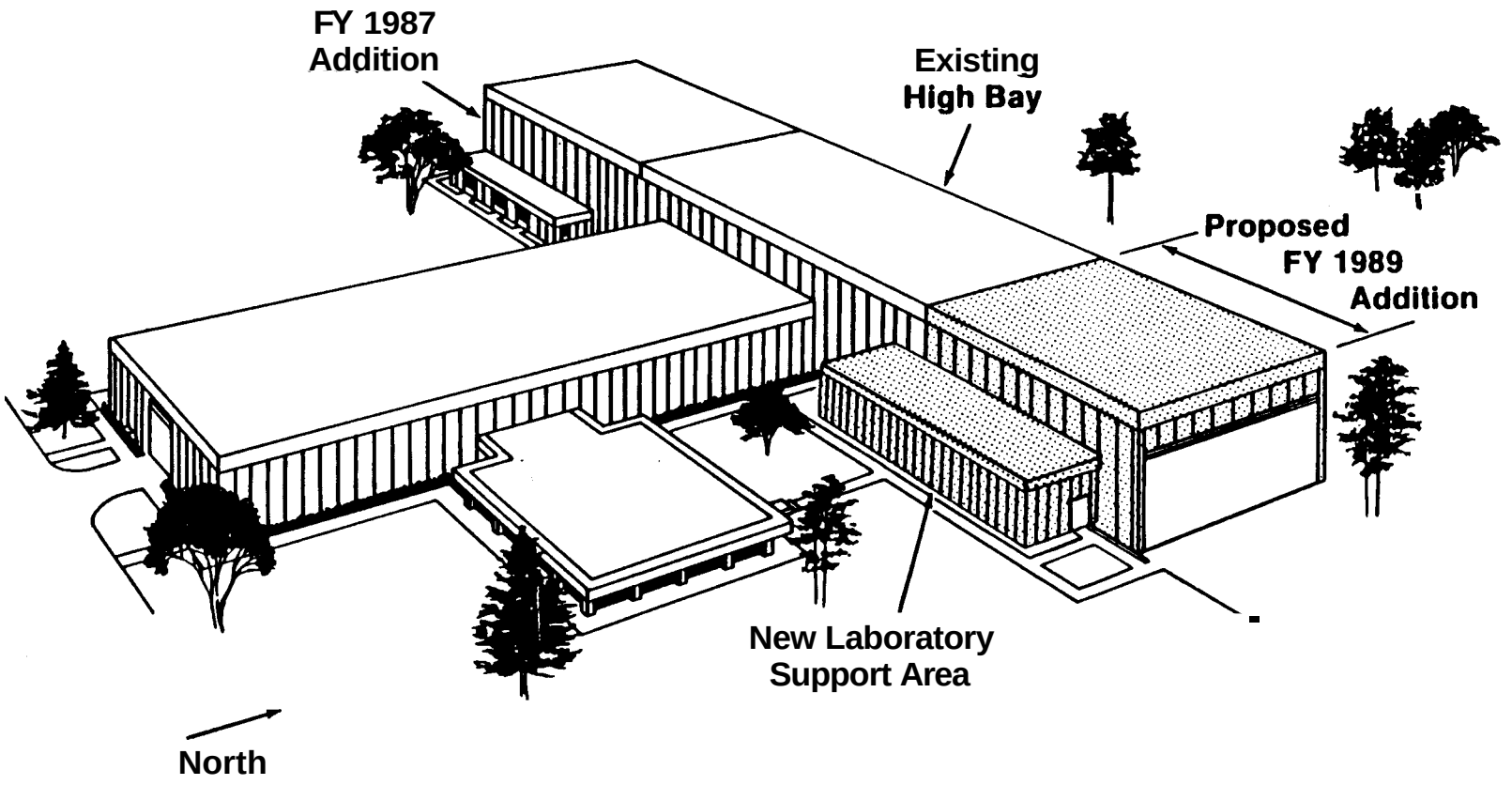


FIGURE 1

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
CONSTRUCTION OF ADDITION- FOR SPACE SYSTEMS
AUTOMATED INTEGRATION AND ASSEMBLY FACILITY

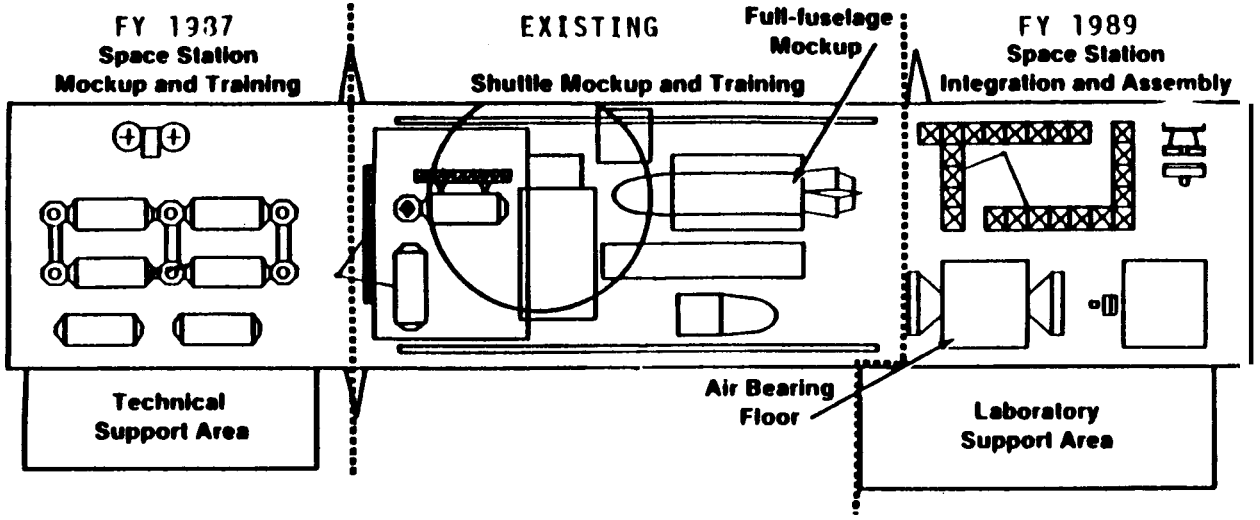


BUILDING PERSPECTIVE

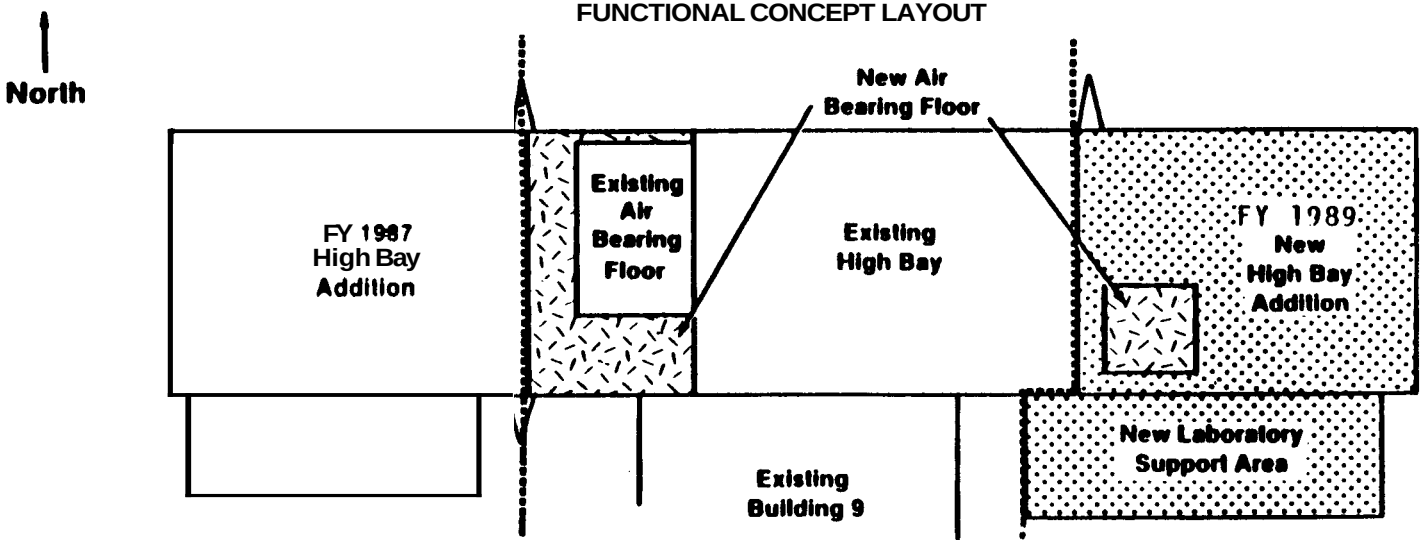
FIGURE 2

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1989 ESTIMATES

CONSTRUCTION OF ADDITION FOR SPACE SYSTEMS
AUTOMATED INTEGRATION AND ASSEMBLY FACILITY



FUNCTIONAL CONCEPT LAYOUT



LAYOUT OF ADDITIONS BY FISCAL YEAR

CONCEPT LAYOUT

FIGURE 3

SPACE FLIGHT
FACILITIES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR *1989* ESTIMATES

SUMMARY

SPACE FLIGHT FACILITIES

	Amount	Page No.
Office of Space Flight:		
Replacement of High Pressure Gas Storage Vessels, National Space Technology Laboratories	*3,500,000*	CF *2-1*
Increase Chiller Capacity, LC-39 Utility Annex, Kennedy Space Center	*2,300,000*	CF *2-6*
Rehabilitation of PAD A, Launch Complex *39*, Kennedy Space Center	*4,600,000*	CF *2-13*
Refurbish Atmospheric Reentry Materials and Structures Evaluation Facility, Johnson Space Center	*4,900,000*	CF *2-20*
Modifications for Advanced Engine Development, Test Stand *116*, Marshall Space Flight center	*13,500,000*	CF *2-27*
Modifications to Orbiter Modification and Refurbishment Facility (OMRF) for Safing and Deservicing, Kennedy Space Center	*2,800,000*	CF 2-35
Construction of National Resource Protection, Various Locations	*2,600,000*	CF *2-42*
Total	*34,200,000*	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Replacement of High Pressure Gas Storage Vessels

INSTALLATION: National Space Technology Laboratories

FY 1989 CoF Estimate: $3,500,000

LOCATION OF PROJECT: NSTL, Hancock County, Mississippi

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	$200,000	---	$ 200,000
Capitalized Investment.....	---	$61,029,074	61,029,074
Total.....	$200,000	$61,029,074	$61,229,074

SUMMARY PURPOSE AND SCOPE:

This project will replace deteriorated High-pressure Gas Storage Vessels in the "B" Test Complex that are used to furnish gases for the Space Shuttle Main Engine (SSME) Testing Program at NSTL. Existing gas storage vessels have been removed from service or are operating on safety standards waivers requiring pressure derating. One 1,500-CF GN_2 storage vessel and one 600-CF of GH_2 storage vessel will be replaced with two 750-CF and one 600-CF high-pressure gas storage vessels.

PROJECT JUSTIFICATION:

The NSTL Pressure Vessel Recertification Program has identified deterioration in several vessels in the "B" Test Complex supporting the SSME Program. Safety standards require that these vessels be derated below the originally designed maximum allowable working pressure or be removed from service.

The Test Complex Pressure Vessels were fabricated in 1964 and have been in continuous service since that time. These vessels are used for storage of gases up to 6,000 psig. The vessels, of laminated construction, are fabricated from HS-1A (T-1) steel. The properties of this steel make it highly susceptible to hydrogen embrittlement and stress corrosion cracking and require replacement at this time.

IMPACT OF DELAY:

Continued deterioration of the remaining vessels is causing continued derating of maximum working pressure or removal from service. This is causing a continued reduction in usable storage capacity which, if not corrected, will result in an inability to continue the SSME test program at NSTL. Ths would shortly result in an inability to fly the Shuttle because of the lack of replacement main engines.

PROJECT DESCRIPTION:

The work includes procurement of two 750-CF GN_2 vessels with a maximum allowable working pressure of up to 6,500 psig; one 600-CF GH_2 vessel, with a maximum allowable pressure of 4,500 psig; installation of a vessel support structure; modification of interconnecting piping; and chemical cleaning and testing of the vessels and modified system. One of the downrated 1,500-CF GN_2 vessels will be converted to high-pressure air to provide better operational efficiency for air drying of the SSME test articles.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	$3,500,000
GN_2 (750 CF + Freight)	EA	2	$1,291,500	2,583,000
GN_2 (600 CF + Freight)	EA	1	764,000	764,000
Site Preparation, Installation, Piping and Valves	LS	1	153,000	153,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				$3,500,000

LIST OF RELATED GRAPHICS:

Figure 1 - NSTL Site Plan
Figure 2 - "B" Test Complex

OTHER EQUIPMENT SUMMARY:

No other equipment will be required to support this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

There will be a future requirement to replace the remaining 1,500-CF GN_2 vessel that has been downrated because of deterioration at an estimated cost of $3,000,000.

NATIONAL SPACE TECHNOLOGY LABORATORIES

FISCAL YEAR 1989 ESTIMATES

REPLACEMENT OF HIGH PRESSURE GAS STORAGE VESSELS

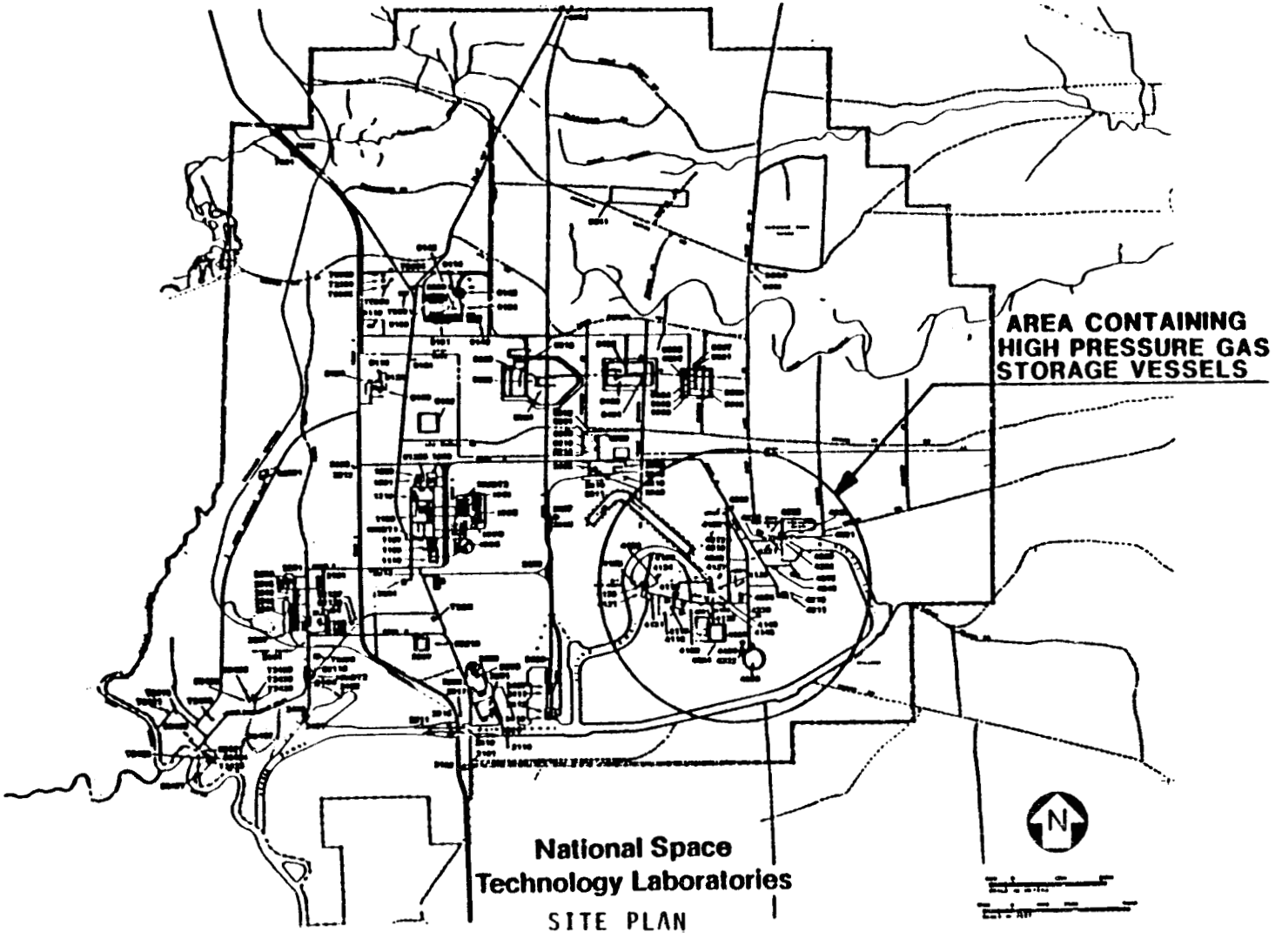
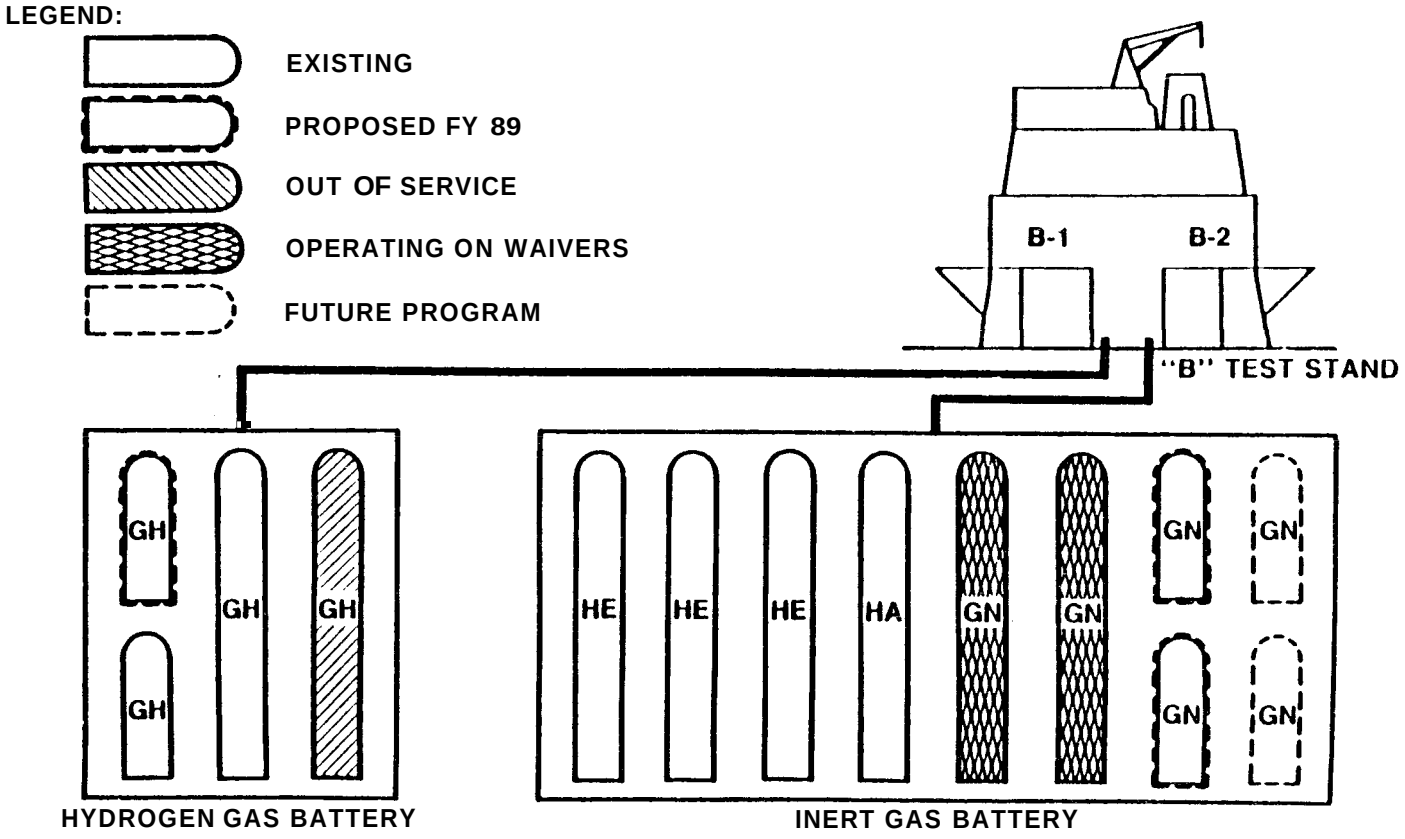


FIGURE 1

NATIONAL SPACE TECHNOLOGY LABORATQRIES

FISCAL YEAR 1989 ESTIMATES

REPLACEMENT OF HIGH PRESSURE GAS STORAGE VESSELS



"B" TEST COMPLEX

FIGURE 2

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Increase Chiller Capacity, LC-39 Utility Annex

INSTALLATION: John F. Kennedy Space Center

FY 1989 CoF Estimate: $2,300,000

LOCATION OF PROJECT: John F. Kennedy Space Center, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding..	$138,000	$ ---	$ 138,000
Capitalized Investment	--	$3,219,979	3,219,979
Total	$138,000	$3,219,979	$3,357,979

SUMMARY PURPOSE AND SCOPE:

This project will add a fifth water chiller (Figure 3) to the Vehicle Assembly Building (VAB) Utility Annex at Launch Complex 39. Growth in cooling requirements coming from the activation of several new facilities will require an additional "on-line" chiller in 1990.

PROJECT JUSTIFICATION:

This project is required to provide the necessary cooling for Shuttle processing activities in the VAB, Launch Control Center (LCC), Orbiter Processing Facility (OPF), OPF Annex, Orbiter Modification and Refurbishment Facility (OMRF), and Thermal Protection System (TPS) Facility in 1990 and following years. Projected cooling requirements will exceed the present capability and an additional 2,500-ton refrigeration unit will be required to support Shuttle processing and launch.

Periodic maintenance requires Chat a chiller be shut down for several days. Scheduling precise shutdown and startup times to coordinate with Shuttle processing and launch schedules cannot always be accomplished, nor can launch schedules be adjusted for chiller maintenance. The needed fifth chiller will allow adequate backup cooling in this highly critical system to ensure launch support with no effect on launch activities or schedules due to chiller maintenance, repair, or failure. This additional chiller will allow any one of the five chillers to be taken out of service for maintenance or repair without impacting Shuttle operations.

IMPACT OF DELAY:

Delay of this project would impact the Space Shuttle program by postponing launch operations whenever one of the current four 2,500-ton chillers is down for maintenance or repair.

PROJECT DESCRIPTION:

This project will provide an additional 2,500-ton refrigeration unit in the VAB Utility Annex and will include the installation of a complete chiller composed of a compressor, evaporator, gearbox, motor control center, motor, pumps, piping, and controls. The new chiller will be located in existing floor space available within the Utility Annex which was planned for this purpose when the Annex was originally built. The existing cooling towers provide adequate capacity to support this additional chiller.

PROJECT COST ESTIMATE:

This cost estimate is based upon engineering estimates prepared by KSC.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	-0-
Construction	---	---	---	$2,300,000
Demolition	LS	---	---	14,000
2,500-ton Chiller	EA	1	1,980,000	1,980,000
Pumps	LS	---	---	80,000
Misc. Mechanical	LS	---	---	40,000
Electrical	LS	---	---	186,000
Equipment	---	---	-0-	---
Fallout Shelter	---	---	---	---
Total				$2,300,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Floor Plan

OTHER EQUIPMENT SUMMARY:

None.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is required to complete this project.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
INCREASE CHILLER CAPACITY, LC-39 UTILITY ANNEX
LOCATION PLAN

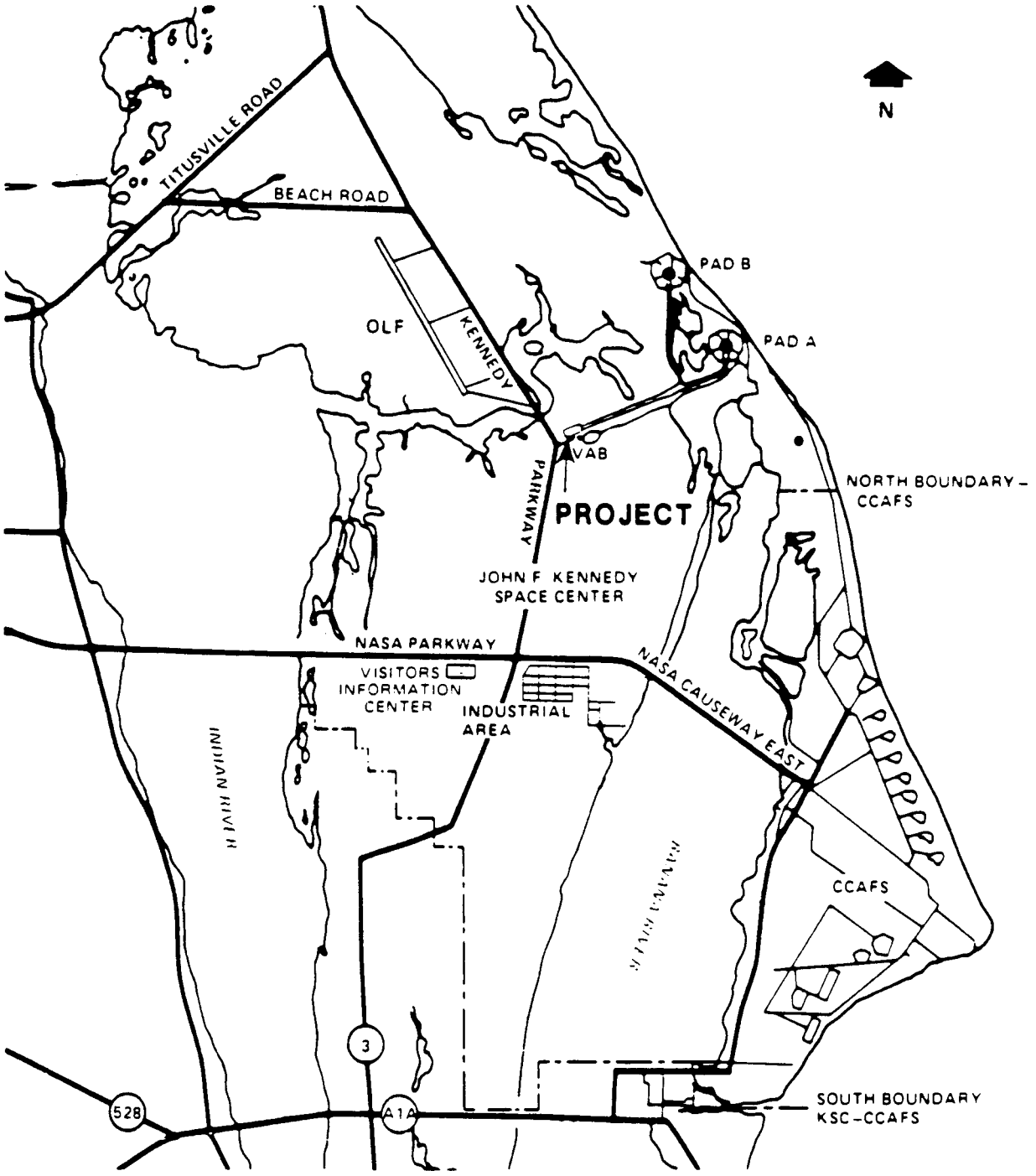


FIGURE 1

JOHN F KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
INCREASE CHILLER CAPACITY, LC-39 UTILITY ANNEX

SITE PLAN

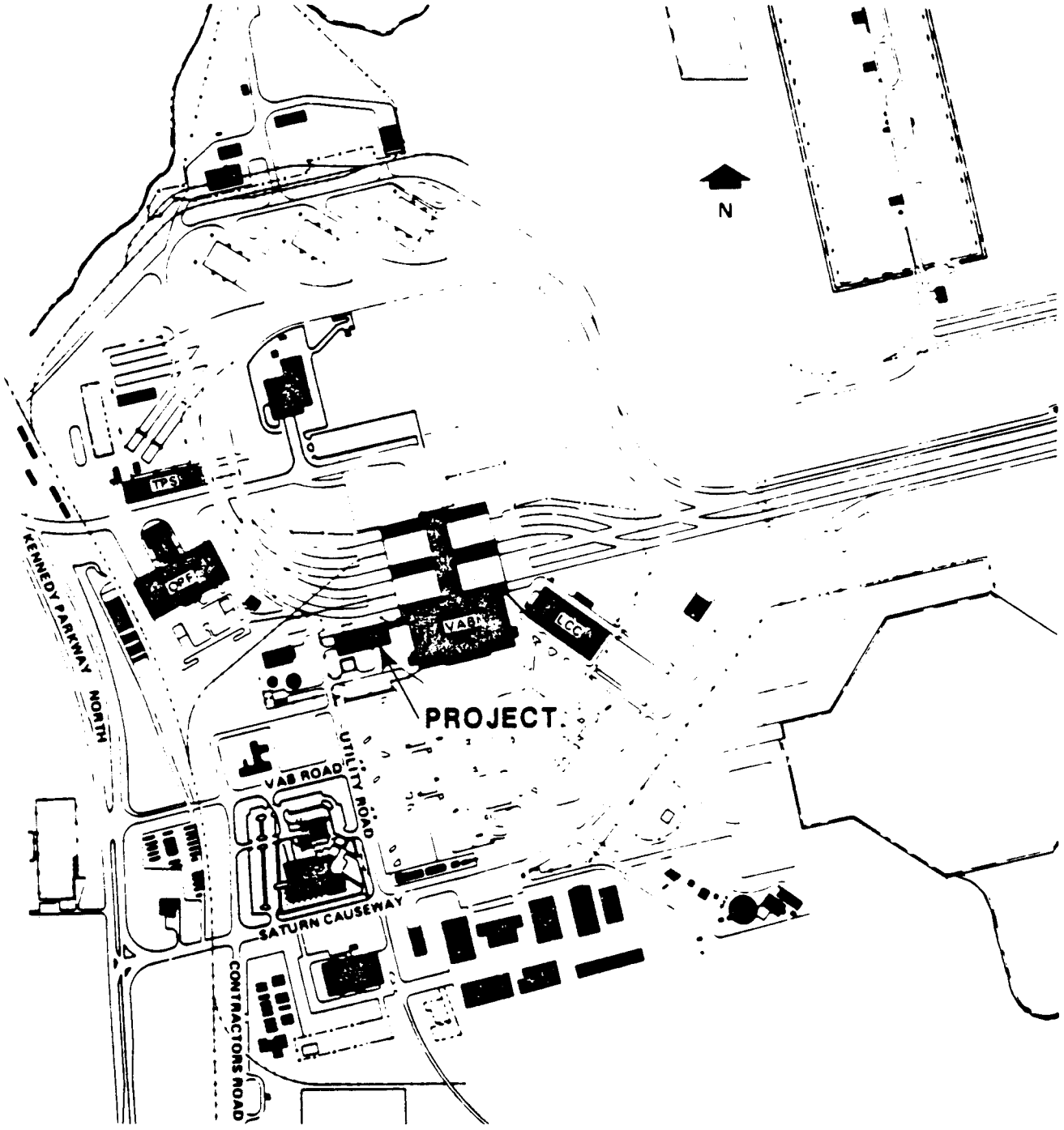


FIGURE 2

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
INCREASE CHILLER CAPACITY, LC 39 UTILITY ANNEX

FLOOR PLAN

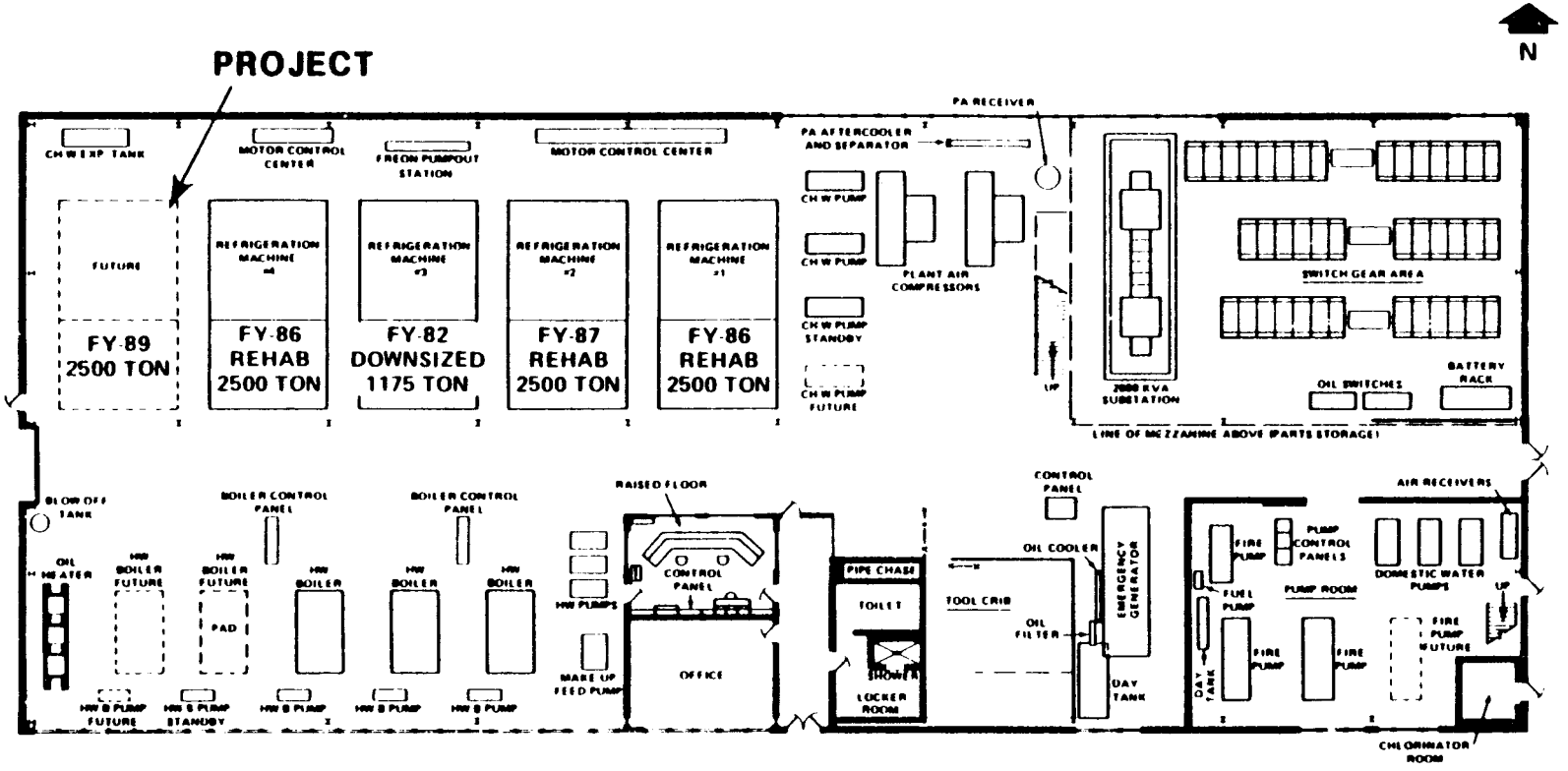


FIGURE 3

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Rehabilitation of Pad A, Launch Complex 39

INSTALLATION: John F. Kennedy Space Center, Florida

FY 1989 CoF Estimate: $4,600,000

LOCATION OF PROJECT: John F. Kennedy Space Center, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding	$316,000	--	$ 316,000
Capitalized Investment	--	$82,710,671	$82,710,671
Total	$316,000	$82,710,671	$83,026,671

SUMMARY PURPOSE AND SCOPE:

This project provides for the rehabilitation of LC-39, Pad A Fixed Service Structure (FSS) elevators and replacement of the Payload Changeout Room (PCR) wall panels to enhance personnel, Shuttle systems, and payloads safety at the launch site.

PROJECT JUSTIFICATION:

The rehabilitations provided by this project directly affect KSC's capability to launch the Shuttle, process payloads, and ensure personnel safety at LC-39, Launch Pad A (Figures 2 and 3).

Rehabilitation of the Fixed Service Structure elevators eliminates a potential unsafe condition. The elevator system was relocated from the Apollo Launch Umbilical Tower and has been in service since 1965. Exposure to the salt environment, launch environment, and Solid Rocket Booster exhaust residue has damaged the system beyond economical repair and it must be replaced.

Rehabilitation of the Payload Changeout Room side walls 1 and 4 are required to preclude contamination of payloads during processing. The type of insulation used inside the existing panels is damaged during launch due to severe vibration and insulation particles are expelled into the PCR requiring extensive decontamination before a new payload can be placed inside the PCR for the next launch.

IMPACT OF DELAY:

In the near future, Pad B can handle the initial Shuttle launches and the work on Pad A can proceed with little interference. By mid-CY 1989, both pads will again be needed. Deferral of this project will extend the construction into an intensely operational period, when access to Pad A for rehabilitation will be restricted with resultant higher construction cost. In addition, higher maintenance and PCR decontamination costs will continue.

PROJECT DESCRIPTION:

The two FSS elevator cabs, rails and support structures will be replaced. The elevator shaft doors and elevator system controls will be replaced or repaired as required. New elevators will be designed which will better withstand the severe launch environment.

The PCR Side 1 and Side 4 wall panels will be removed and replaced with new panels. An elasticmeric, non-flaking coating system will be applied to the interior side of the panels. Additional structural bracing will be installed similar to Pad B to reduce unsupported areas of the panels and reduce vibration during launch. Cabling and piping penetrations will be reworked to minimize the number of penetrations and provide a more positive seal.

PROJECT COST ESTIMATE:

The basis of this cost estimate is a preliminary engineering report (PER).

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	--	--	--	--
Construction				$4.600. 000
Site Development				$359. 000
Elevator Demolition	LS	2	$116,000.00	(232. 0001
PCR Panel Demolition	SF	5. 032	25.24	(127. 000)
Structural				1.036. 000
Elevators	LS	--	--	(454. 000)
PCR Panels	SF	5. 032	115.66	(582. 000)
Mechanical				2.106. 000
Elevators	LS	--	--	(1.815. 000)
Wall Panels	LS	--	--	(291. 000)
Electrical				1.099. 000
Elevators	LS	--	--	(757. 000)
Wall Panels	LS	--	--	(342. 000)
Equipment	--	--	--	--
Fallout Shelter (not applicable)	--	--	--	--
Total				$4.600. 000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Perspective

OTHER EQUIPMENT SUMMARY:

None

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is required to complete this project.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
REHABILITATION OF PAD A, LAUNCH COMPLEX 39
LOCATION PLAN

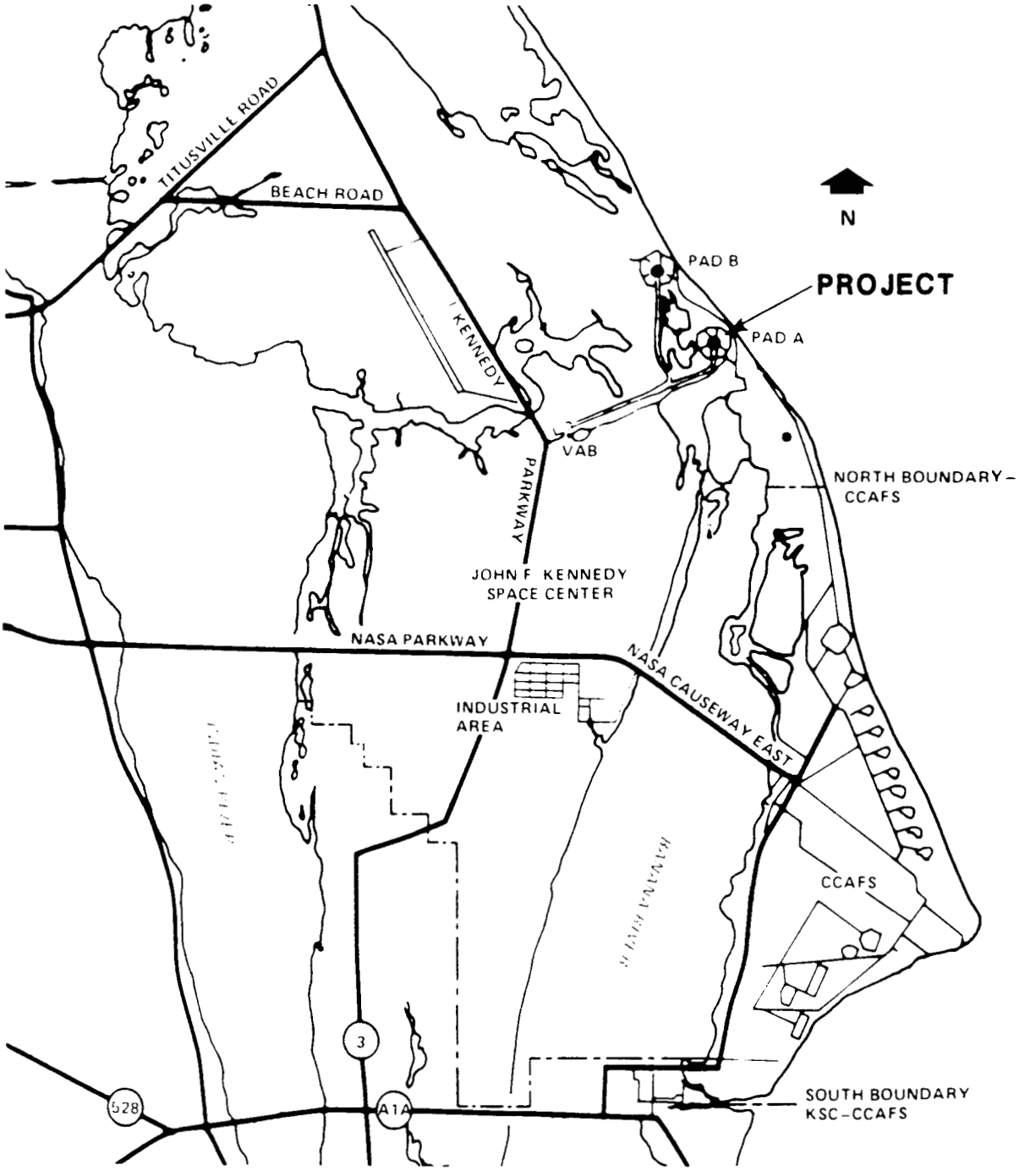


FIGURE 1

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
REHABILITATION OF PAD A, LAUNCH COMPLEX 39
SITE PLAN

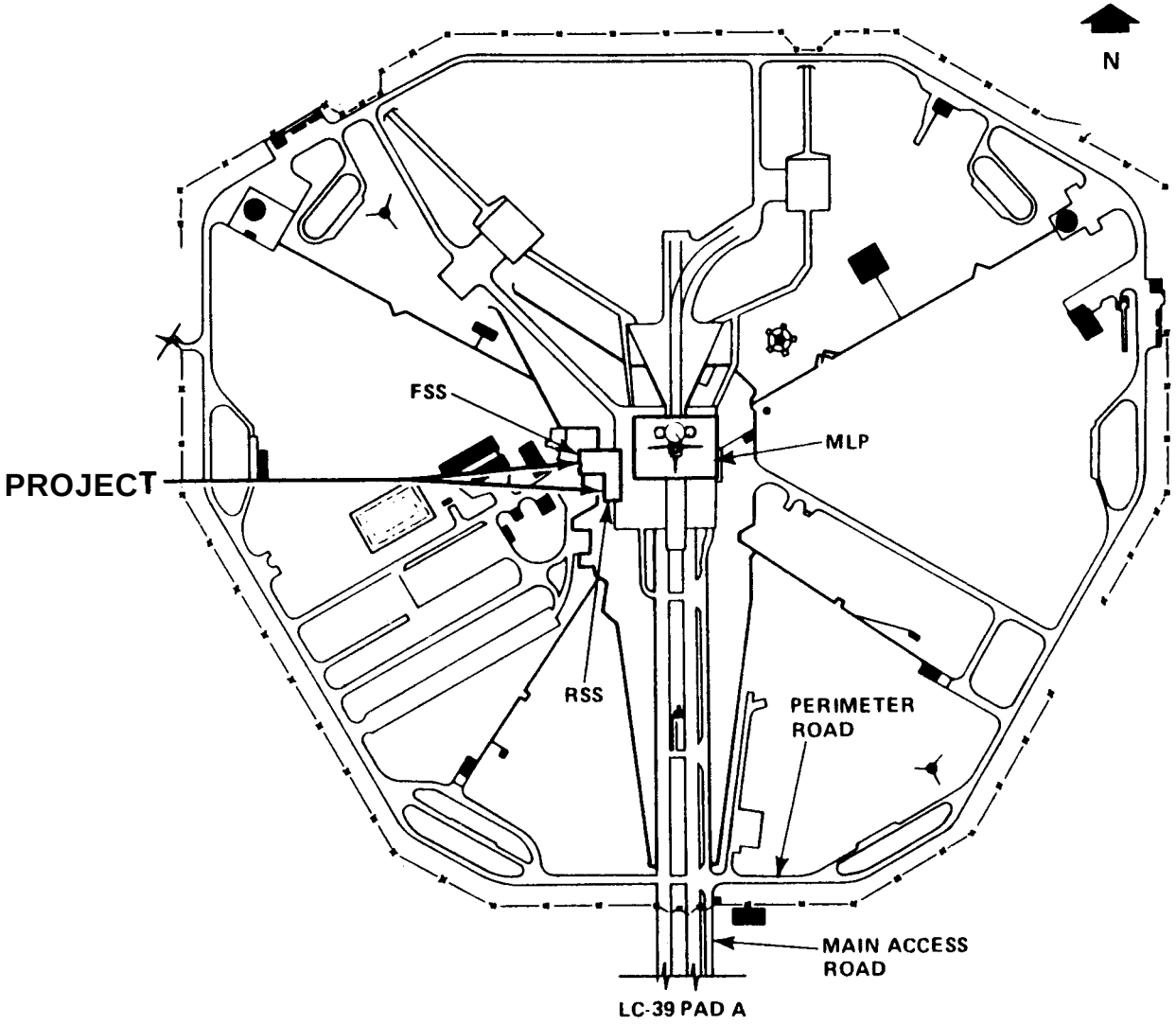


FIGURE 2

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
REHABILITATION OF PAD A, LAUNCH COMPLEX 39
PERSPECTIVE

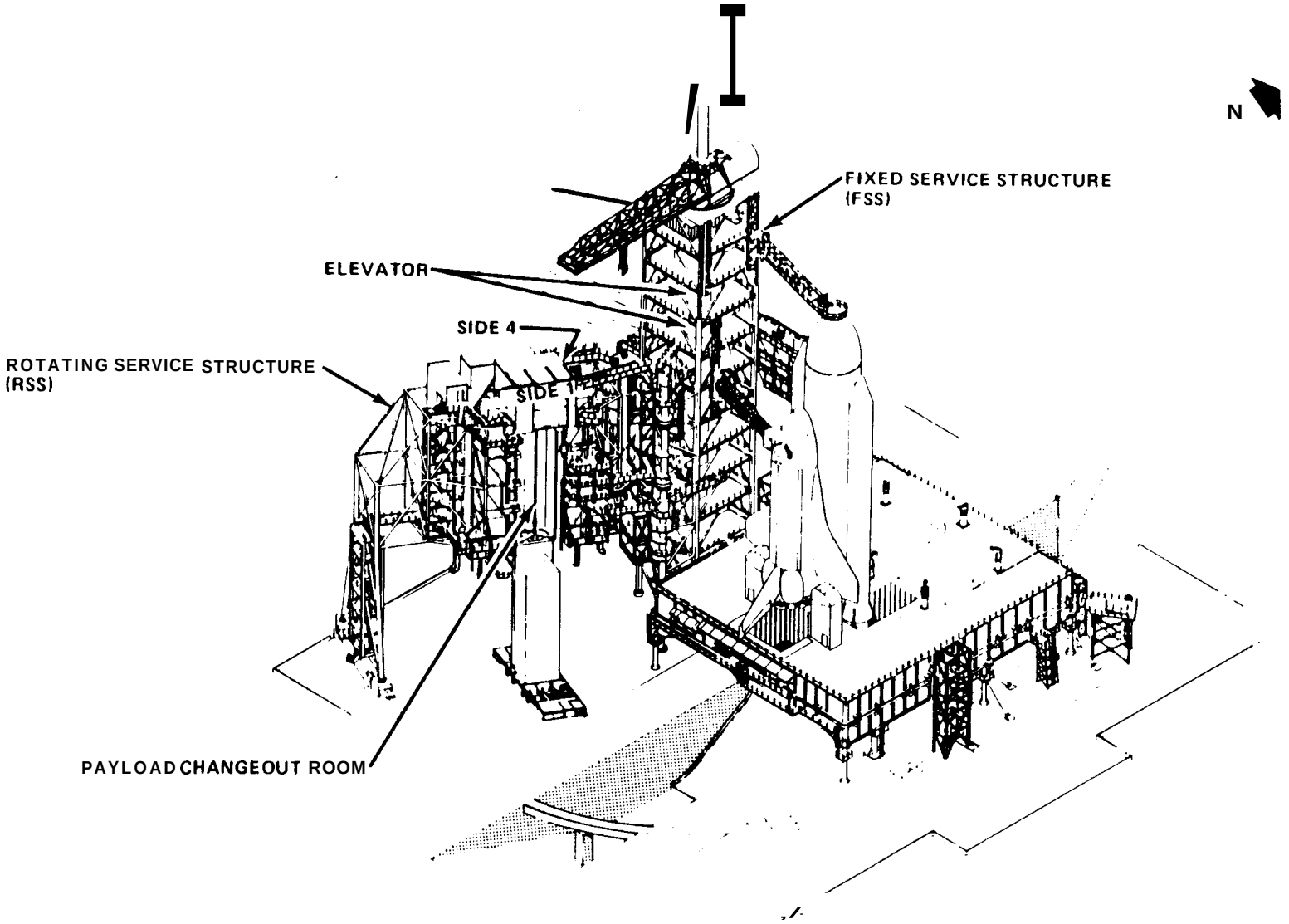


FIGURE 3

PROJECT TITLE: Refurbish Atmospheric Reentry Materials and Structures Evaluation Facility

INSTALLATION: Lyndon B. Johnson Space Center

FY 1989 CoF Estimate: $4,900,000

LOCATION OF PROJECT: Houston, Harris County, Texas

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	$392,000	$ -0-	$ 392,000
Capitalized Investment.....	-0-	2,744,430	2,744,430
Total.....	$392,000	$2,744,430	$3,136,430

SUMMARY PURPOSE AND SCOPE:

This project replaces one of the two test positions in the 10-Mw Atmospheric Reentry Materials and Structures Evaluation Facility (ARMSEF), Building 222, used for testing and evaluation of the Space Shuttle orbiter thermal protection system (TPS). The work includes replacing a 20-year-old deteriorated test chamber, diffuser, and boiler system. The new equipment will include the test capability to develop, evaluate, and certify thermal protection systems for application on aeroassisted orbital transfer vehicles.

PROJECT JUSTIFICATION:

The 10Mw ARMSEF was constructed in 1968 to support testing of the nonreusable ablator used on the Apollo Command Module reentry vehicle and was upgraded in 1972 by adding a second test position to provide a reentry environment suitable for the testing of all types of reusable TPS employed on the Shuttle Orbiter. The ARMSEF was the lead facility for the selection and initial testing of Shuttle Orbiter TPS and presently uses both of its test chambers to support the resolution of Shuttle TPS flight anomalies and ongoing TPS engineering. The deteriorated test chamber and diffuser were carbon-steel construction. Cooling water between the double walls over the years has corroded the metal causing numerous leaks in the test chambers and diffuser. Because of reduced diffuser capability, the test chamber has been derated from its full 10 Mw capability to 5 Mw. The boilers which supply steam to the ejector system are also constantly leaking because of age. Many of the boiler tubes have been replaced or plugged. Each time there is a leak, testing is delayed. The leaking of high-temperature water or steam also presents a safety hazard. This project will replace one test chamber, diffuser, and associated boilers so that the test position can be restored to its full 10Mw capability.

The refurbished test position will continue to support Shuttle TPS engineering, but will also have the capability to develop and certify TPS for the aeroassisted orbital transfer vehicles (AOTV's).

IMPACT OF DELAY:

The project is needed now to replace failing facility test systems which are at the end of their service life. Without this project, JSC will be impeded in its support of ongoing Shuttle TPS sustaining engineering, will sustain high operating costs, and will be unable to provide effective reentry environment TPS test and certification, not only for the Shuttle program, but for other TPS test programs.

PROJECT DESCRIPTION:

This project upgrades the 10-Mw ARMSEF, Building 222. It demolishes the existing test chamber and provides a new 12-foot-diameter reentry environment vacuum test chamber at Test Position #2. The new test chamber includes chamber internals, a new diffuser, and a new aftercooler. Also provided is a new contoured channel nozzle and new cross-tie vacuum ducting to link test chambers at Test Position (TP) #1 and TP #2 to a single existing steam ejector vacuum pumping system.

This project also provides a new 80,000-pounds-per-hour saturated steam boiler to replace two failing boilers. The new boiler will drive an existing steam ejector vacuum pumping system which will evacuate the reentry environment test chambers at TP #1 and TP #2 through the new cross-tie vacuum ducting. Additionally, the project will provide a new boiler building, new steam main, relocation of associated equipment, replacement of deteriorated underground water supply lines, and demolition of two existing steam boiler systems.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	Cost
Land Acquisition.....	---	---	---	---
Construction.....	---	---	---	$4,900,000
12-foot-diameter test chamber.....	EA	1	1,600,000	1,600,000
Contoured channel nozzle.....	EA	1	500,000	500,000
Diffuser, aftercooler, ducting & valves.....	LS	---	---	1,265,000
Steam boiler, building & accessories.....	EA	1	1,535,000	1,535,000
Total				$4,900,000

LIST OF RELATED GRAPHICS:

Sheet 1 - Location Plan
Sheet 2 - Isometric of New Configuration, Building 222
Sheet 3 - Plan View of New Configuration, Building 222

OTHER EQUIPMENT SUMMARY:

No other equipment is required for this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is required to complete this project.

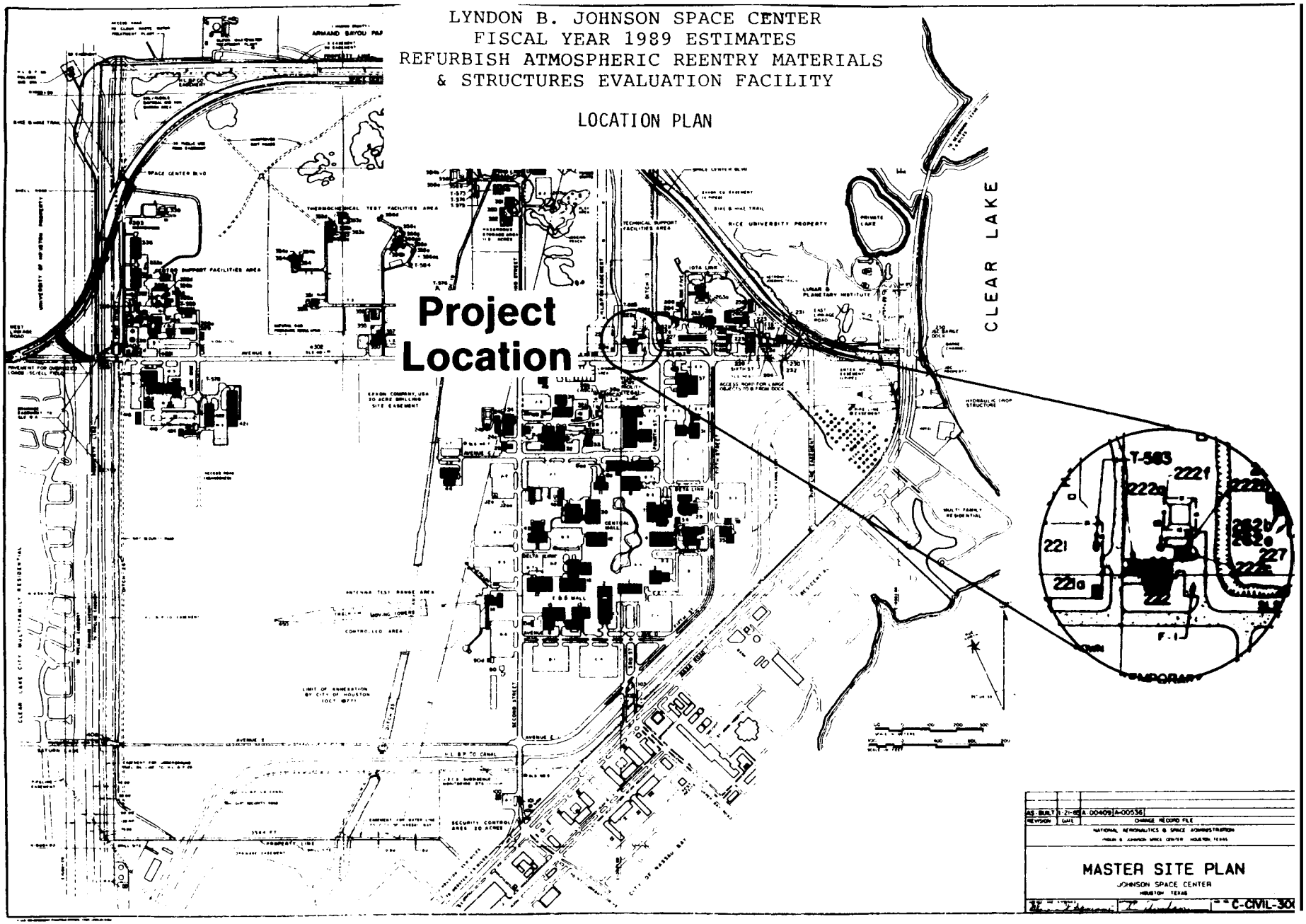
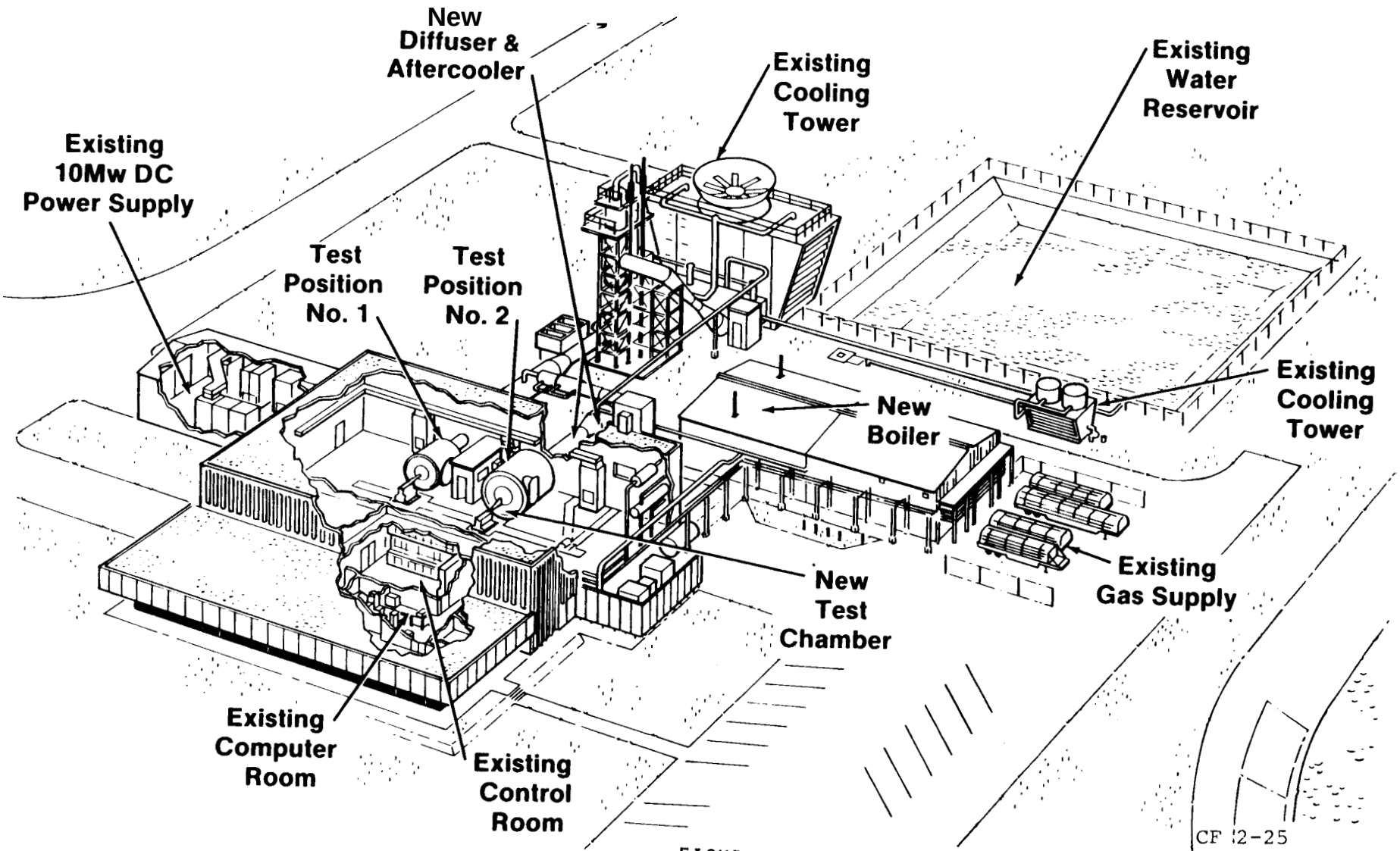

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
REFURBISH ATMOSPHERIC REENTRY MATERIALS
& STRUCTURES EVALUATION FACILITY
LOCATION PLAN
Project Location
CLEAR LAKE
MASTER SITE PLAN
JOHNSON SPACE CENTER
HOUSTON TEXAS

FIGURE 1

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
REFURBISH ATMOSPHERIC REENTRY MATERIALS
& STRUCTURES EVALUATION FACILITY

ISOMETRIC



CF 12-25

FIGURE 2

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
REFURBISH ATMOSPHERIC REENTRY MATERIALS
& STRUCTURES EVALUATIOK FACILITY

PLAN VIEW

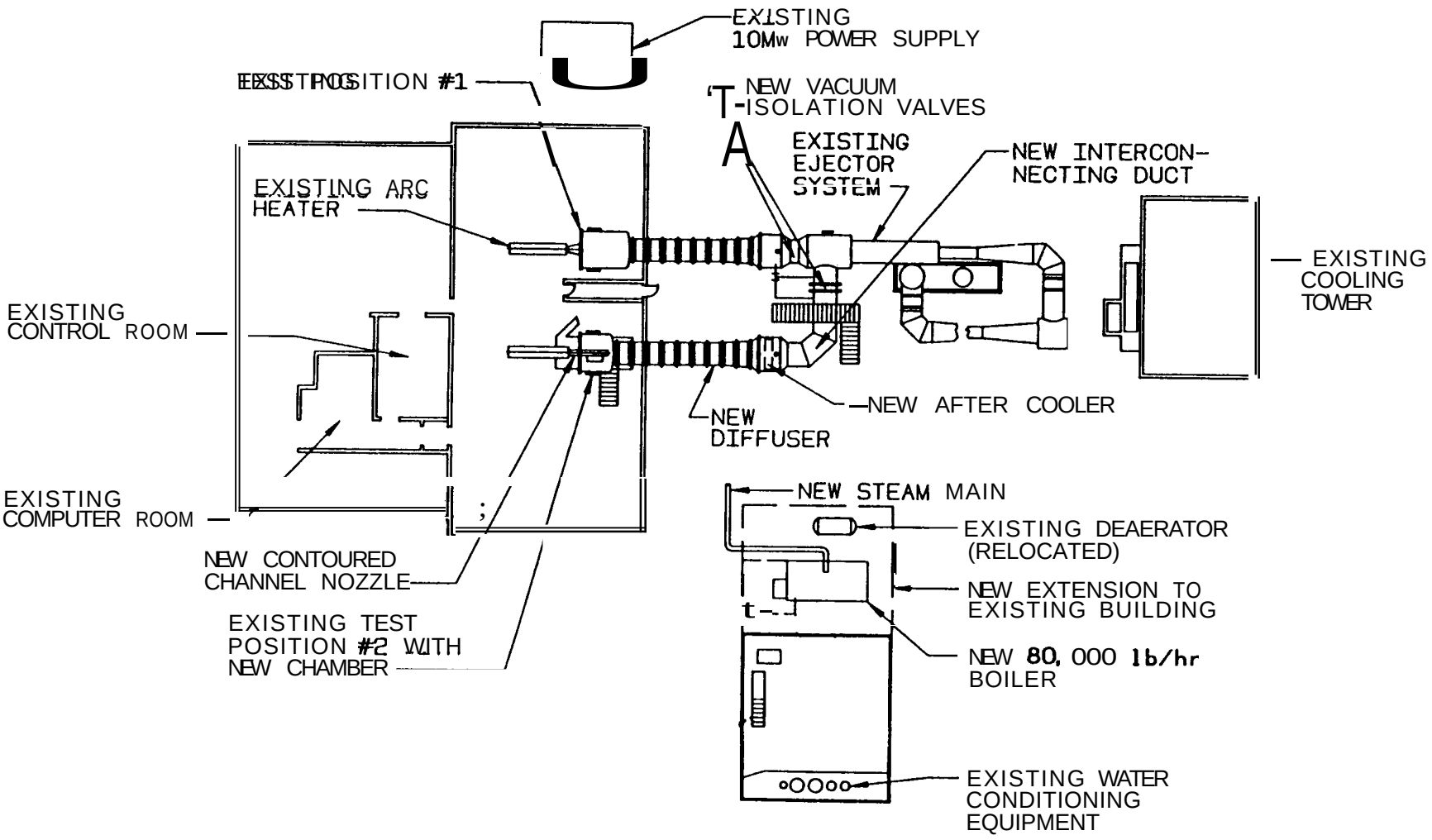


FIGURE 3

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Modifications for Advanced Engine Development, Test Stand 116

INSTALLATION: George C. Marshall Space Flight Center

FY 1989 CoF Estimate: $13,500,000

LOCATION OF PROJECT: Marshall Space Flight Center, Madison County, Alabama

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	$1,121,400	N/A	$1,121,400
Capitalized Investment.....	N/A	$2,110,608	$2,110,608
Total.....	$1,121,400	$2,110,608	$3,232,008

SUMMARY PURPOSE AND SCOPE:

This project provides for modifications to Test Stand 116 to test the components of a new advanced liquid oxygen-hydrocarbon 750,000 pound thrust engine. The objective of this testing is to establish and verify new propulsion technology at the component level such as the main combustion chamber (MCC), gas generators (GG) and preburners (PB). This will enable an optimum design of components that will lead to assembly of new full-scale advanced test engines. This is a technology development effort in direct support of the Civil Space

Technology initiative efforts to develop higher-performance engines for future NASA use. The technology development efforts will also have application to the Advanced Launch System (ALS), Space Transportation Booster Engine (STBE), and Space Transportation Main Engine (STME).

PROJECT JUSTIFICATION:

The initial development activities of an advanced oxygen-hydrocarbon booster engine are in the initial planning phases. Difficulties with injector development have historically been much more severe with hydrocarbon fuels than with hydrogen. This has been especially true from the standpoint of combustion instability. It is essential that the advanced oxygen-hydrocarbon engine programs have available pressure-fed test facilities for injector and combustion stability work prior to pump-fed engine testing. Marshall Space Flight Center (MSFC) is NASA's lead center for developing space launch engines, and will perform technology testing required to define and resolve critical development issues including materials, fuel compatibility, and combustion stability. To accomplish this, technology testing of key components, such as the main combustion chamber (MCC), will be tested at three levels with the two lower thrust levels being scaled-down versions of the MCC. The test levels which are needed are (1) injector and combustion chamber performance and heat transfer testing at a thrust level of 40,000-70,000 pounds, (2) dynamic stability testing of two-dimensional combustion chambers at approximately 250,000 pounds of thrust, and (3) full-size combustion chamber stability testing at approximately 750,000 pounds of thrust.

The capability for test level (1) currently exists at Test Stand 116 and this data is being forwarded to the advanced engine development contractors. This test position is the most complete and most flexible pressure-fed facility in the country, but it is limited in thrust level to approximately 70,000 pounds. Existing large, high-pressure tanks at the facility provide an excellent base for uprating to 750,000 pounds thrust. Work included in this project will provide the capability to satisfy test level (2) and (3) requirements.

IMPACT OF DELAY:

The development of an advanced, high-pressure, oxygen-hydrocarbon booster engine cannot proceed until large-thrust pressure-fed test facilities are made available. This facility is key to NASA's continued ability to develop the technology necessary for the next generation of space launch engines.

PROJECT DESCRIPTION:

Work includes constructing a 250/750 pound thrust structure (Figure 2), a new 225-square foot static input unit (SIU) reinforced concrete structure for the new and relocated controls and instrumentation, a 20-foot by

40-foot addition to test stand support Building 4539, an addition to the blockhouse (Building 4541), and interior modification to Building 4583. Mechanical work includes installing GFE pressure vessels consisting of one 2,000-gallon, 8,500 psig LH_2/LNG; three 625-cubic foot, 15,000 psig GH_2/GNG; three 625-cubic foot, 10,000 psig GN_2; one 500-gallon, 9,300 psig LOX; and one 625-cubic foot, 15,000 psig GH_2. Existing pressure vessels to be relocated consist of nine 15-cubic foot and six 100-cubic foot, 10,000 psig GN_2; one 700-cubic foot, 8,000 psig GN_2; and one 3,000-gallon, 6,000 psig LOX. A new burn stack will be installed for methane disposal. Work also includes constructing a new 15,000 psig methane gas-generating facility and upgrading 15,000 psig hydrogen (Building 4657) and 10,000 psig nitrogen (Building 4659) gas-generating facilities with pumps and vaporizers and running cross-country GH_2, GNG, and GN_2 lines approximately 5,000 linear feet. Some landfill, vessel foundations, and other site work will be required, while the sound power system, data acquisition, control system, and firex system will be modified or added as required.

PROJECT COST ESTIMATE:

This cost estimate is based on an engineering study.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition.....	---	---	---	---
Construction.....	---	---	---	$13,500,000
Mechanical.....	LS	---	---	5,534,900
Gas Generation Facilities.....	LS	---	---	3,668,400
Control Systems.....	LS	---	---	2,204,700
Structures Building Modifications and Site Preparation.....	LS	---	---	1,233,900
Instrumentation.....	---	---	---	858,100
Equipment.....	---	---	---	---
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				$13,500,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Test Stand Area Layout
Figure 3 - Configuration Required for Updated Test Conditions

OTHER EQUIPMENT SUMMARY:

Equipment to be funded from R&D resources will be test specific pressure vessels, engine instrumentation and control systems, high-pressure pumps and vaporizers, and liquid high-pressure lines from the run tanks to the thrust structure, with an estimated cost of $13,800,000.

FUTURE CoF FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF resources are required to complete the present scope of this project for advance LOX/HC-750K Thrust Engine development. Future modifications may be required for Turbopump Assemblies development.

MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1989 ESTIMATES
MODIFICATIONS FOR ADVANCED ENGINE DEVELOPMENT
TEST STAND 116
LOCATION PLAN

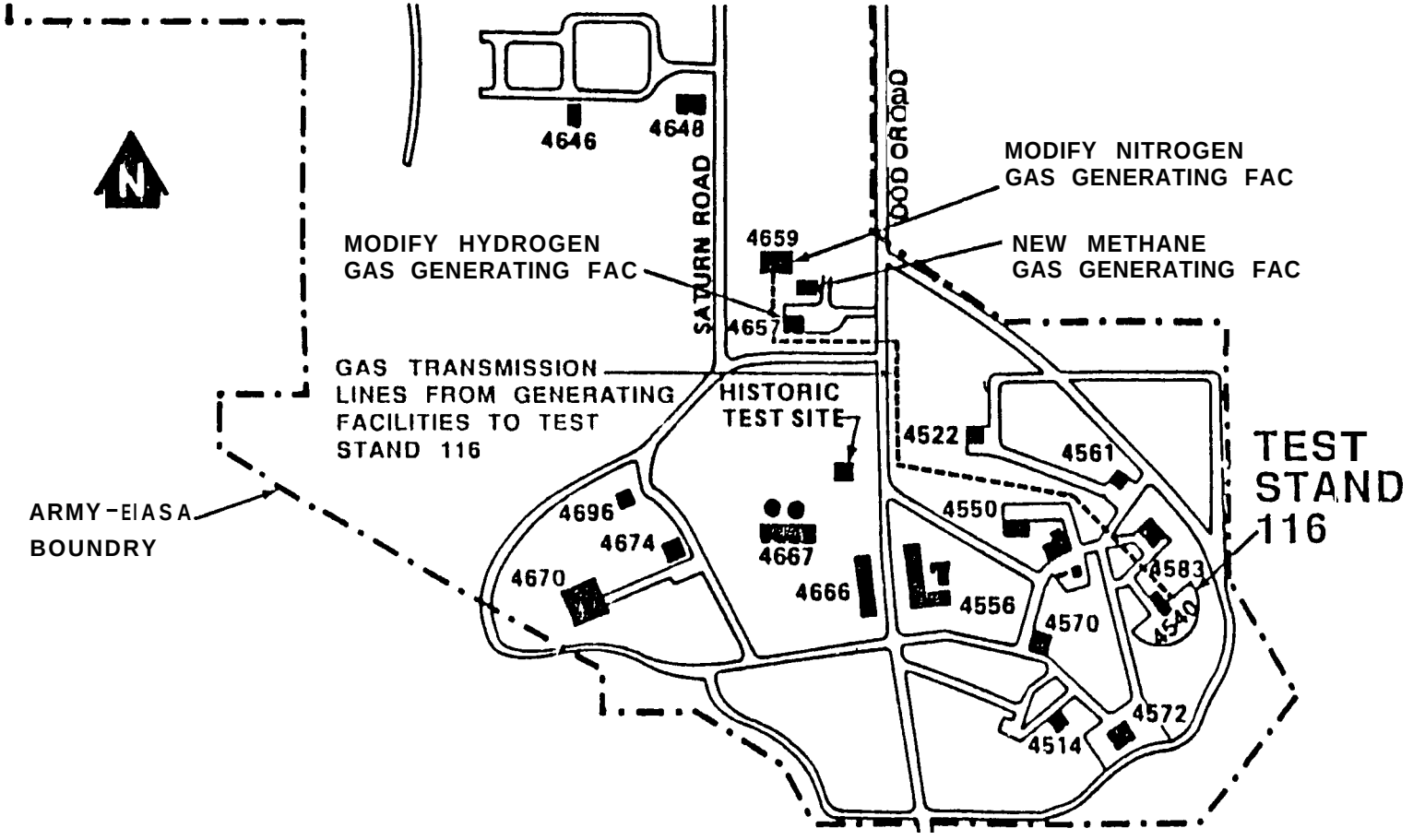


FIGURE 1

MODIFICATIONS FOR ADVANCED ENGINE DEVELOPMENT TEST STAND 116

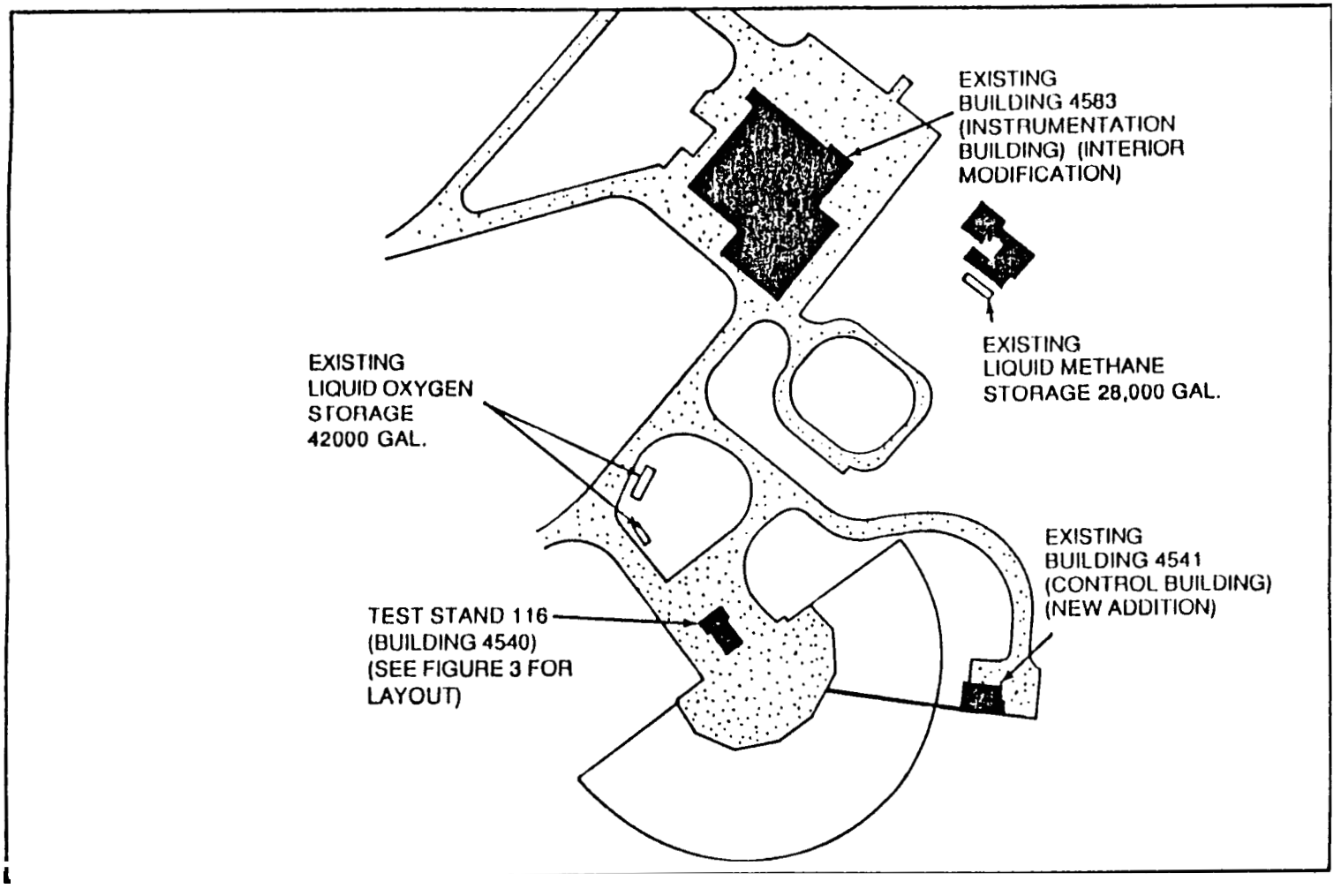


FIGURE 2 TEST STAND AREA LAYOUT

MODIFICATIONS FOR ADVANCED ENGINE DEVELOPMENT TEST STAND 116

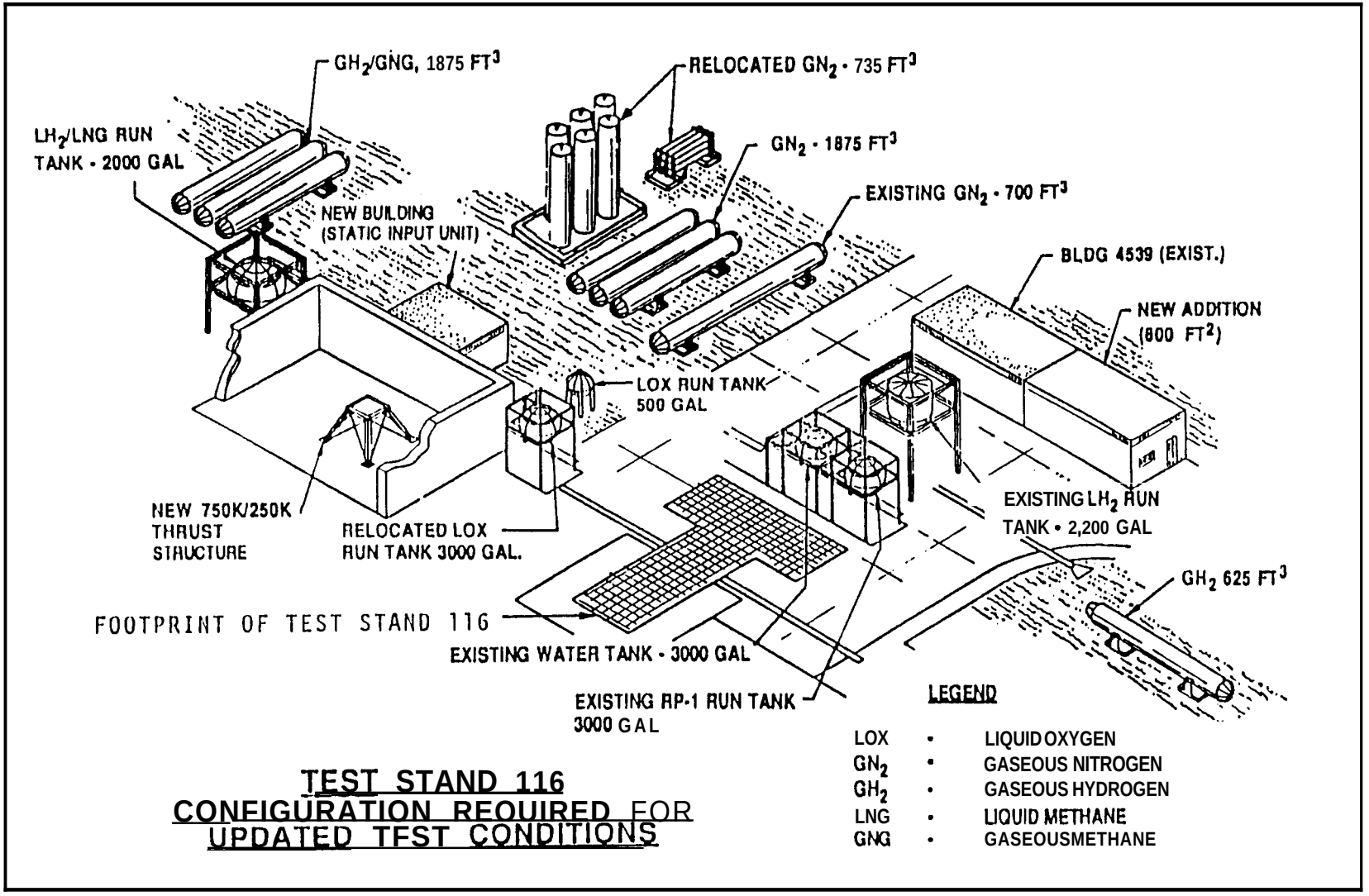


FIGURE 3

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Modifications to Orbiter Modification and Refurbishment Facility (OMRF) for Safing and Deservicing

INSTALLATION: John F. Kennedy Space Center

FY 1989 CoF Estimate: $2,800,000

LOCATION OF PROJECT: John Kennedy Space Center, Brevard County, Florida

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding	$196,000	$ ---	$196,000
Capitalized Investment	---	---	---
Total	$196,000	$196,000	$196,000

SUMMARY PURPOSE AND SCOPE:

This project provides orbiter safing and deservicing capabilities in the Orbiter Modification and Refurbishment Facility (OMRF). This capability will allow returning orbiters to be safed and deserviced without disrupting orbiters being processed for launch in the Orbiter Processing Facility (OPF).

PROJECT JUSTIFICATION:

Upon returning from a space mission, an orbiter must undergo immediate safing, maintenance, and checkout before it can begin processing for reuse. Currently, processing orbiters for reuse is totally performed in the OPF and includes such major on-line operations as draining and purging all fuel systems, removing ordnance and all other hazardous elements, removing payloads brought back from space, inspecting the payload bay and crew cabin, repairing and replacing damaged components, and refurbishing the thermal protection system. Currently, the OMRF provides an off-line facility for performing major orbiter modifications and refurbishment. It was not provided with safing and deservicing capabilities. With current facilities, an orbiter being processed in the OPF for reuse must be temporarily removed so that immediately required safing and deservicing operations can be performed on a returning orbiter. This disruption causes a 9-day delay in orbiter processing.

Prior to the 51-L accident, the present OPF and OMRF were sufficient for anticipated needs. However, the post 51-L test and checkout requirements have increased the OPF processing time for each orbiter such that the 9-day loss of processing time cannot be accommodated.

IMPACT OF DELAY:

Shuttle manifests and operational schedules are dependent upon continual OPF availability for processing of orbiters for reuse. If facilities needed to avoid temporary removal of orbiters from the OPF are not brought on line, Shuttle turnaround and manifest launch rates cannot be met.

PROJECT DESCRIPTION:

This project will provide capability within the OMRF to safe and deservice an orbiter. This includes capability for hypergols deservicing, gaseous and liquid hydrogen, gaseous and liquid oxygen, gaseous nitrogen and gaseous helium systems, hydraulics and ground coolant piping. These systems will connect to existing sources external to the building and be terminated in the OMRF floor trenches. In addition, power upgrades and contamination control features will be added to the OMRF.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition.....	---	--	--	--
Construction.....	---	--	--	$1,302,000
Site Development.....	LS	--	--	555,000
Elect. Ductbanks & Power Upgrade.....	LS	--	--	232,000
Contamination Control.....	LS	--	--	515,000
Equipment.....	---	--	--	1,498,000
Hypergol Deservicing System.....	LS	--	--	310,000
Gaseous Hydrogen & Oxygen System.....	LS	--	--	150,000
Liquid Oxygen & Hydrogen System.....	LS	--	--	320,000
Gaseous Nitrogen Systems...	LS	--	--	325,000
Gaseous Helium System.....	LS	--	--	250,000
Ground Coolant System Piping.....	LS	--	--	53,000
Hydraulic System Room.....	LS	--	--	90,000
Fallout Shelter (not applicable).....				---
TOTAL.....				$2,800,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Floor Plan

OTHER EQUIPMENT SUMMARY:

Equipment to be funded with SFCDC resources will consist of scrubbers, tanks, hoses, fittings, purge connections, and cable plants with an estimated cost of $26,500,000.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is anticipated for this project.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
MODIFICATIONS TO OMRF FOR SAFING AND DESERVICING
LOCATION PLAN

CF Z-39

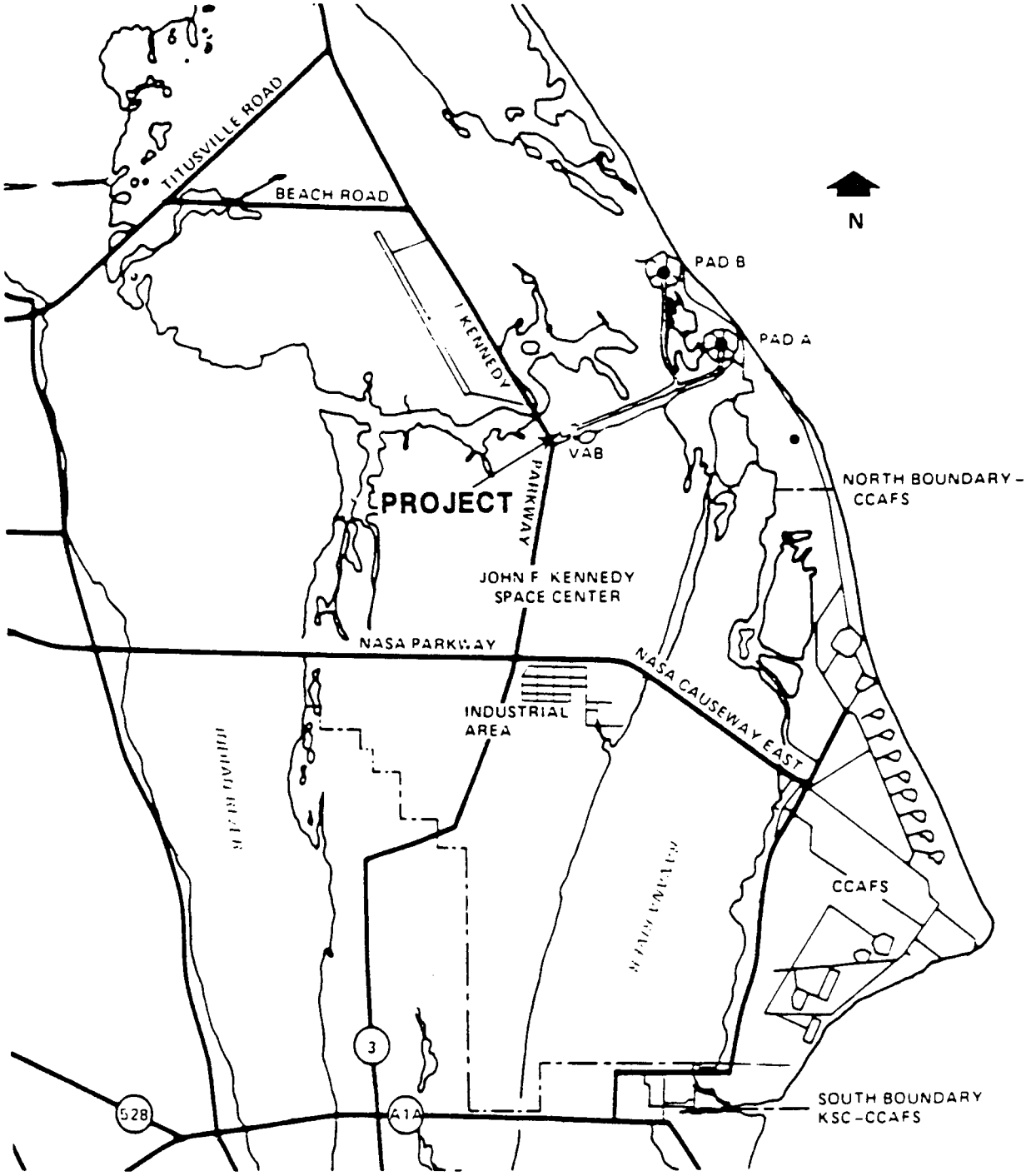


FIGURE 1

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
MODIFICATIONS TO OMRF FOR SAFING AND DESERVICING

SITE PLAN

CF 2-40

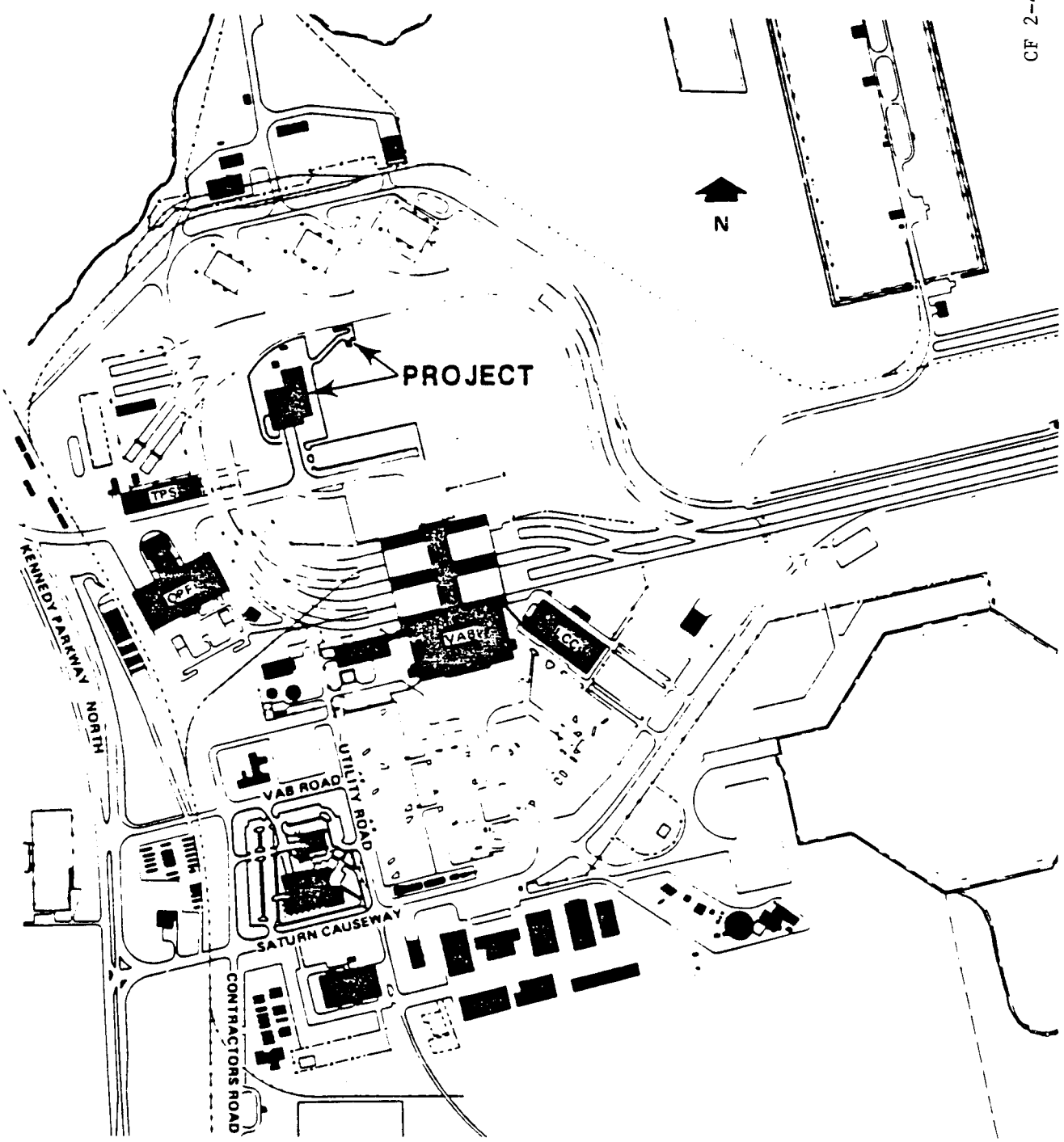


FIGURE 2

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
MODIFICATIONS TO OMRF FOR SAFING AND DESERVICING

PLAN VIEW

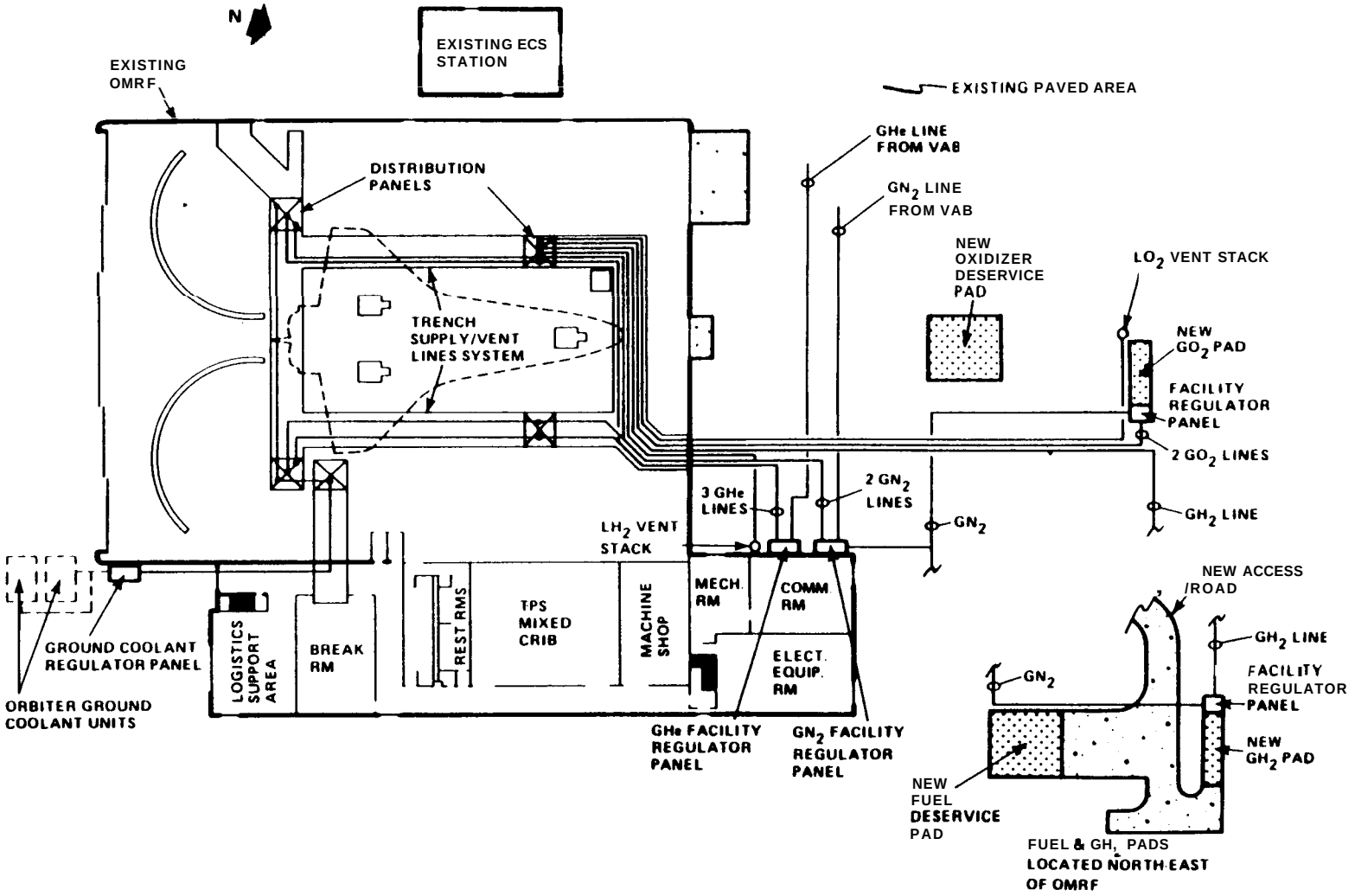


FIGURE 3

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Construction of National Resource Protection

INSTALLATION: Various Installations

FY 1989 CoF Estimate: $2,600,000

LOCATION OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding....	--	--	--
Capitalized Investment.....	--	N/A	N/A
Total.....	--	--	--

SUMMARY PURPOSE AND SCOPE:

This project provides security protection for Space Transportation System (STS) and related facilities which have been designated a vital national resource at the John F. Kennedy Space Center (KSC) and Dryden Flight Research Facility (DFRF). This protection includes constructing fencing, guardhouses, and perimeter lighting to protect all designated vital STS assets against sabotage, damage, and theft.

PROJECT JUSTIFICATION:

Presidential Decision Memorandum Number 37 (National Space Policy, 1978), Presidential Directive/NSC, Number 42 (Civil and Further National Space Policy, (1978), and National Security Decision Directive Number 42 (National Space Policy, July 4, 1982) contain policy designating space systems and support systems as vital national resources. This designation specifically referenced the Space Transportation System (STS), and required that the survivability of the STS be assured in order to be available for military, scientific, and research uses. STS survivability requires that protective measures be in place at all times to ensure proper, efficient, and effective operation.

IMPACT OF DELAY:

Delay of this project increases the vulnerability of National Resources to adversaries. Lack of protective facilities increases the requirement for security manpower. Implementation of protective facilities becomes more difficult as the mission rate increases.

PROJECT DESCRIPTION:

This project provides for construction of seven-foot-high double chainlink fencing, 3-strand barbed wire, concertina wire, automatic gates, guardhouses, perimeter lighting, and all electrical work needed to support the lighting, guardhouses, and automatic gates. Facilities to be protected by this project are Pad B at Launch Complex 39 (KSC), Orbiter Processing Facility (KSC), Vehicle Assembly Building/Launch Control Center (KSC), Shuttle Mate-Demate Structure (DFRF), Shuttle Hangar (DFRF), and other smaller Shuttle facilities (DFRF). These facilities have been classified as category "A" which, if lost, could cause the loss of an orbiter or crew or would result in an STS program delay greater than 6 months.

PROJECT COST ESTIMATE:

This cost estimate is based on an engineering study

	Unit of Measure	Quantity	Unit Cost	Cost
Land Acquisition	---	---	---	--
Construction	---	---	---	$2,600,000
Fencing and miscellaneous	Lump	1	---	1,380 000
Guardhouses	Lump	1	---	540 000
Perimeter lights	Lump	1	---	330 000
Electrical work and controls	Lump	1	---	350 000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	--	--	--	---
Total	..	..	..	$2,600,000

LIST OF RELATED GRAPHICS:

Figure 1 - KSC Location Plan
Figure 2 - KSC Site Plan
Figure 3 - DFRF Location Plan

OTHER RELATED FUNDING:

In the research and program management appropriation there are $2.0 million in FY 1988 for related equipment and $6.4 million in FY 1989 for additional equipment and related services.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

CoF resources may be required to provide for additional security protection for STS and other facilities designated a vital national resource.

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
CONSTRUCTION OF NATIONAL KESOUKCE PROTECTION

LOCATION PLAN

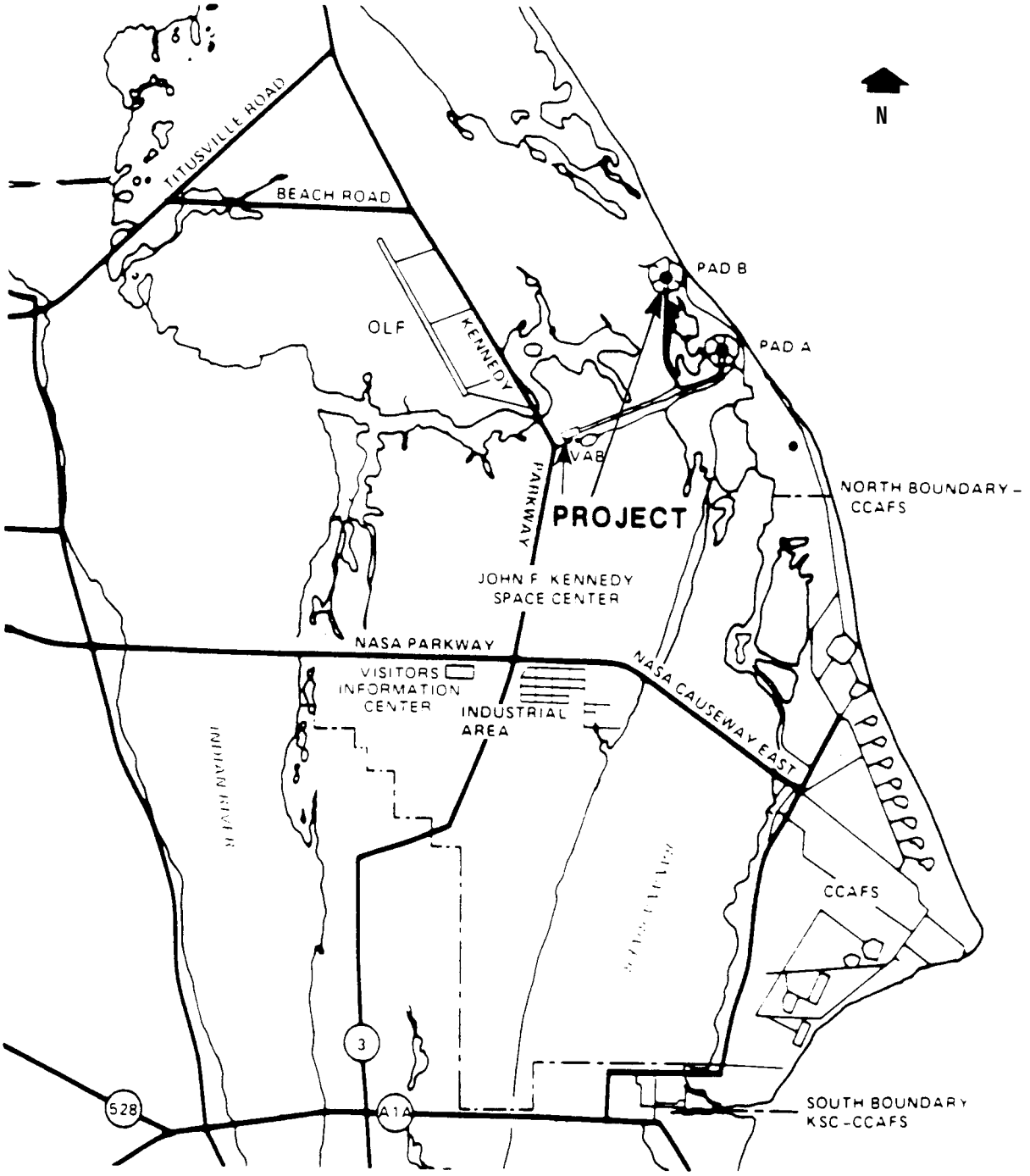


FIGURE 1

JOHN F. KENNEDY SPACE CENTER
FISCAL YEAR 1989 ESTIMATES
CONSTRUCTION OF NATIONAL RESOURCE PROTECTION

SITE PLAN

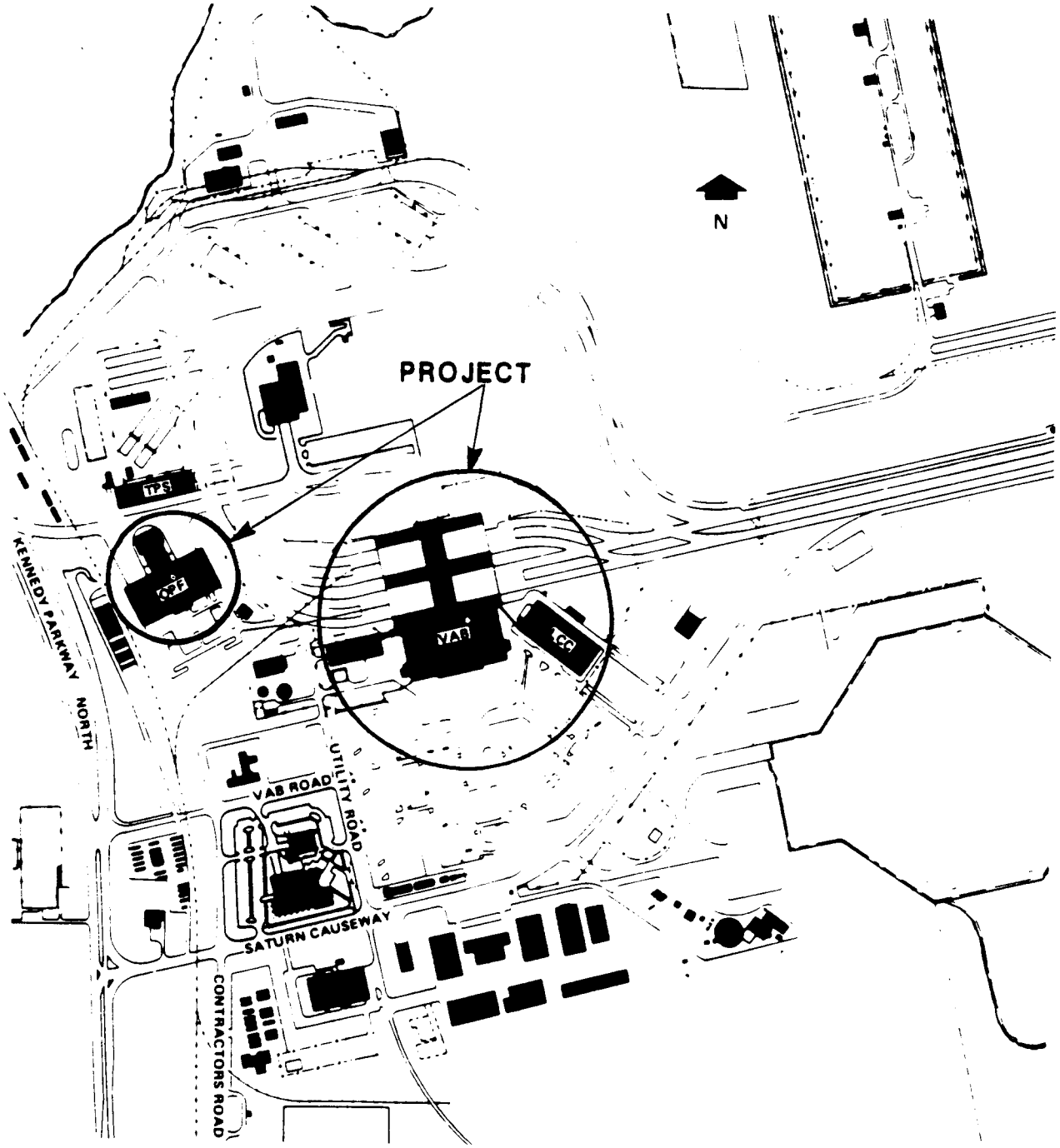


FIGURE 2

DRYDEN FLIGHT RESEARCH FACILITY
FISCAL YEAR 1989 ESTIMATES
CONSTRUCTION OF NATIONAL RESOURCE PROTECTI

LOCATION PLAN

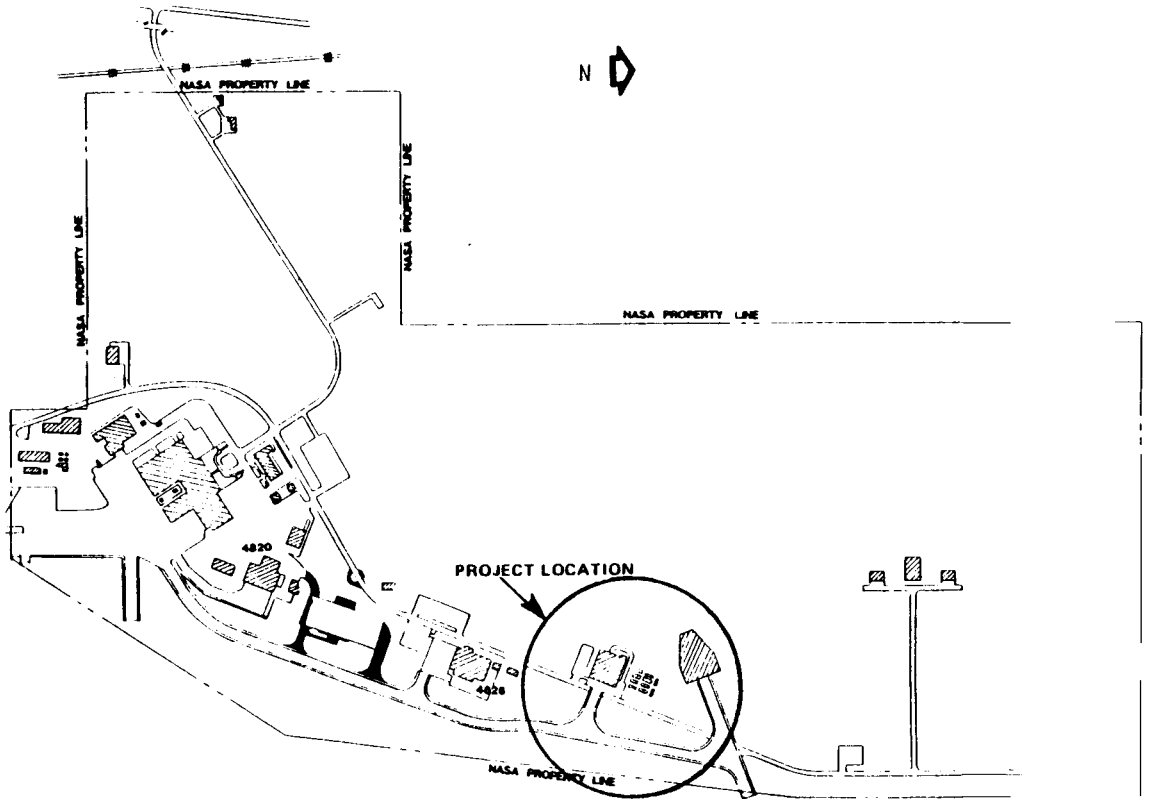


FIGURE 3

JOHNSON
SPACE CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

JOHNSON SPACE CENTER

	Amount	Page No.
Office of Space Flight:		
Construction of Auxiliary Chiller Facility	7,800,000	CF 3-1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Construction of Auxiliary Chiller Facility

INSTALLATION: Lyndon B. Johnson Space Center

FY 1989 CoF Estimate: $7,800,000

LOCATION OF PROJECT: Houston, Harris County, Texas

COGNIZANT HEADQUARTERS OFFICE: Office of Space Flight

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	$714,000	-0-	$714,000
Capitalized Investment.....	-0-	-0-	-0-
Total.....	$714,000	-0-	$714,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the construction, outfitting, and tie-in of a new 6,000 square foot auxiliary chilled water generating facility. Two 2,000-ton electrically driven chillers are required to accommodate increasing demand from existing facilities and new floor space that will be added at the JSC main site through the early 1990's.

PROJECT JUSTIFICATION:

This project is required to provide additional chilled water capacity to meet significant usage and floor space growth that is occurring and planned for the JSC main site through the early 1990's. JSC's chilled water usage has been increasing steadily over the past several years, primarily because of the installation of additional and more powerful computing equipment. In addition, JSC technical facilities and office space continue to be more extensively utilized. Daily chilled water requirements temporarily exceeded the Center's safety margin operating capacity of 10,000 tons during the summer of 1985 and will permanently exceed it in 1988. Projected chilled water requirements growth indicates that the Center's total operational capacity of 12,000 tons will be permanently exceeded by the end of 1989.

The age and condition of the existing chillers contribute to the shortfall and vulnerability of the JSC chilled water generation capability. The seven 2,000-ton chillers in the central plant have been in operation approximately 25 years. Prudent operating procedures require sufficient capacity to allow for one chiller to be available for standby reserve and one chiller to be out of service for maintenance. However, due to the increasing load and the frequent need for chiller maintenance, reliable operation of the needed number of chillers cannot be assured.

The new 4,000-ton chilled water production facility provided by this project will accommodate the increasing cooling needs and provide backup and permit overhaul of the existing chillers. The planned location of the new chiller facility provides enough physical separation to reduce common vulnerability to catastrophic events while being close enough to the existing central plant to accommodate unmanned remote control of the new facility.

IMPACT OF DELAY:

If this project is not approved, there will not be adequate chilled water capacity to operate the Center in 1990 and beyond. Failure of one or more of the existing chillers after this date could make it necessary to vacate or close some functional areas of JSC until repairs can be made.

PROJECT DESCRIPTION:

This project provides for the construction, outfitting, and tie-in of a new auxiliary chilled water production facility. The facility building will be approximately 6,000 square feet and contain two 2,000-ton electrically driven chillers. Also included are the installation of new chilled water pumps, cooling water pumps, piping, cooling towers, transformers, and metal-clad switchgear with vacuum breakers to power the new

chillers. The work also will include installing new 1,200-ampere 15-kV breakers in the site substation and new feeders to the new chiller plant. Space has been provided in the building for installation of additional chillers and auxillary equipment in future years, should it be necessary.

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	$7,800,000
Site Preparation	LS	---	---	239,000
Chiller Building	SF	6,000	75.50	453,000
Mechanical:				
2,000-Ton Chillers and Pumps	LS	---	---	2,845,000
30-Inch Underground Chilled Water Line, Valves, Sleeve Under Street	LF	4,500	267.33	1,203,000
Electrical:				
New 15-kV Feeders, 15-kV Switchgear, 15-kV Breakers, Ductbanks, Transformers, Starters, and Uninterruptible Power Supply	LS	---	---	2,001,000
Cooling Towers	EA	2	489,500	979,000
Crane	LS	---	---	80,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				*$7,800,000*

LIST OF RELATED GRAPHICS:

Figure 1 - Project Location
Figure 2 - Projected Chilled Water Usage
Figure 3 - Layout Plan

OTHER EQUIPMENT SUMMARY:

None

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding will be required to complete this project, however, space has been provided for further expansion which may be needed in the late 1990's.

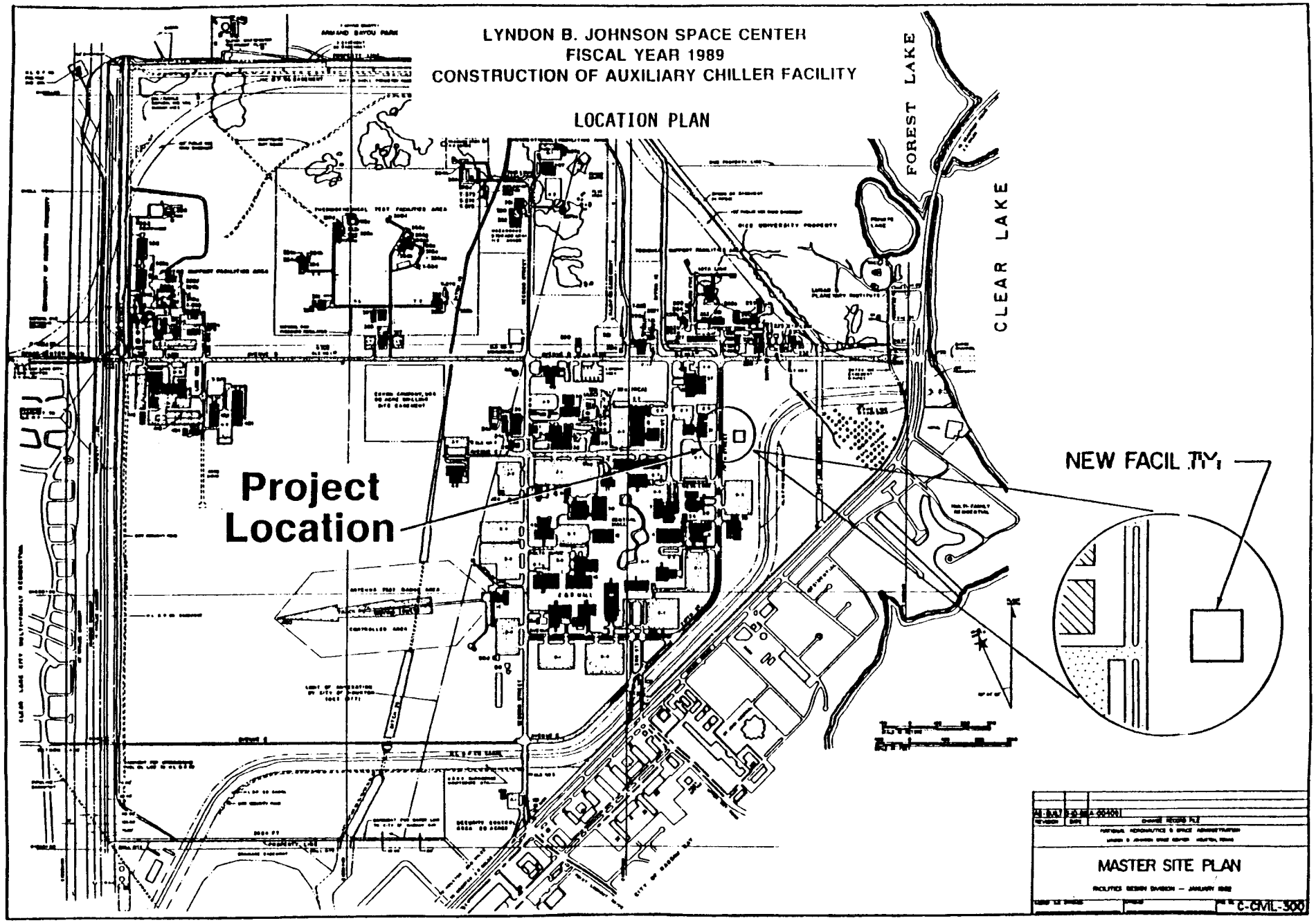

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1989
CONSTRUCTION OF AUXILIARY CHILLER FACILITY
LOCATION PLAN
FOREST LAKE
CLEAR LAKE
Project Location
NEW FACILITY
MASTER SITE PLAN
C-CMIL-300

FIGURE 1

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1989
CONSTRUCTION OF AUXILIARY CHILLER FACILITY

JSC PROJECTED CHILLED WATER USAGE

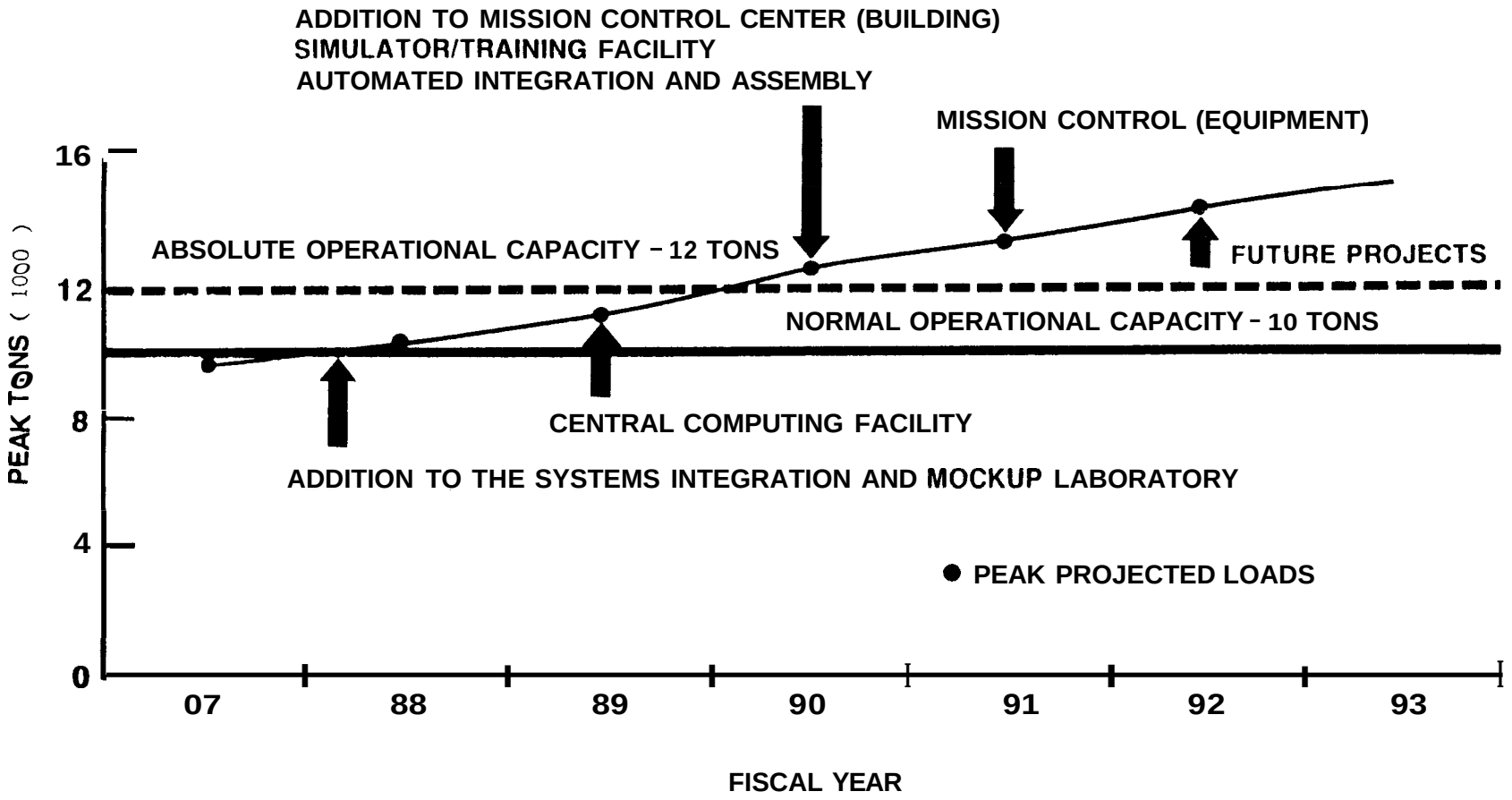


FIGURE 2

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1989
CONSTRUCTION OF AUXILIARY CHILLER FACILITY

LAYOUT PLAN

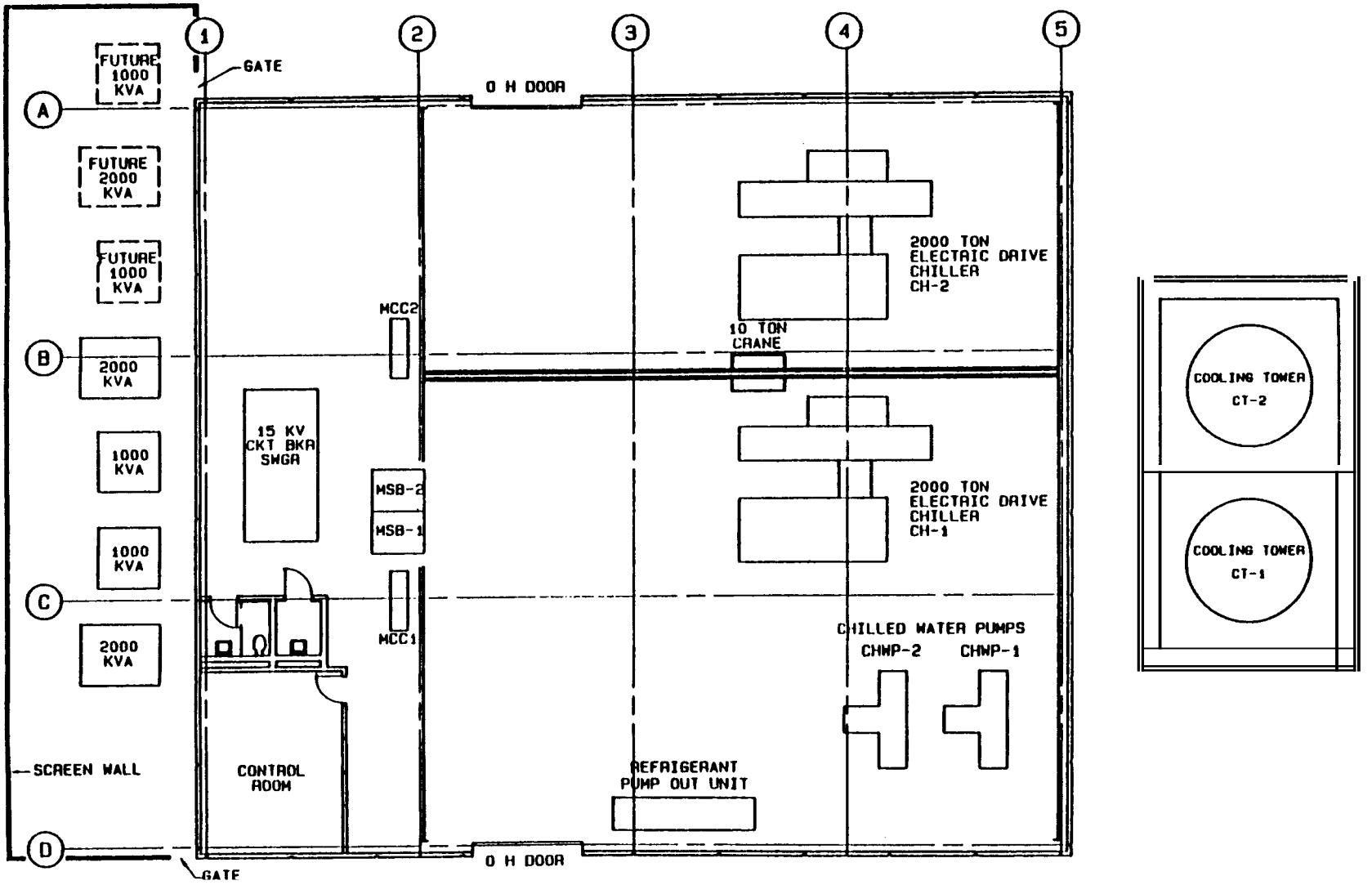


FIGURE 3

MARSHALL
SPACE FLIGHT CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

MARSHALL SPACE FLIGHT CENTER

	Amount	Page No.
Office of Space Science and Applications:		
Modifications to the X-Ray Calibration Facility (XRCF)	11,400,000	CF 4-1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Modifications to the X-Ray Calibration Facility (XRCF)

INSTALLATION: George C. Marshall Space Flight Center

FY 1989 CoF Estimate: $11,400,000

LOCATION OF PROJECT: Marshall Space Flight Center, Madison County, Alabama

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science and Applications

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding..	$912,000	---	$ 912,000
Capitalized Investment	---	$3,113,000	$3,113,000
Total	$912,000	$3,113,000	$4,025,000

SUMMARY PURPOSE AND SCOPE:

This project will modify the XRCF instrument chamber in Bldg. 4708 to accommodate the extended focal length of the x-ray mirror assemblies for the Advanced X-ray Astrophysics Facility (AXAF). The instrument chamber building and associated clean room will be enlarged and the control room relocated. The guide tube diameter will be increased and the tube will be lengthened to provide the degree of precision needed to calibrate and measure mirror performance. The AXAF is one of NASA's series of "Great Observatories in Space" and will

perform detailed long-term study of deep space x-ray emissions. The AXAF is a Space Science and Applications new start planned for FY 1989 and this facility is essential to supporting this program.

PROJECT JUSTIFICATION:

The modifications to the XRCF are required for the ground testing and calibration of the performance of the High Resolution Mirror Assembly (HRMA) and instrumentation. Such testing is mandatory for evaluation of the x-ray reflection efficiency and resolution of individual mirrors; for calibration and final alignment testing; for functional testing to determine final performance; and to calibrate x-ray instrumentation necessary for the development of the computer software required for the interpretation and analysis of the scientific and engineering data generated by the spacecraft.

The instruments involved in this program must be tested in a facility with a long evacuated path length to provide a nearly parallel beam of radiation similar to that arriving from deep space which can be used for testing, calibration, and alignment. The long path length is necessary because collimating mirrors (as used with visible light) cannot be used for x-rays. The most practical means for testing is to provide a nearly parallel beam of radiation using a long distance between the radiation source and exposing the instruments to only a very narrow angle of the x-rays arriving from the source. Since radiation at x-ray lengths is heavily attenuated in air, the path length of the radiation must be evacuated. This facility will provide the needed capabilities for testing and is on the "critical path" for meeting the overall project schedule.

Additional uses for the facility will be for calibration of rocket payloads for extreme ultraviolet and x-ray experiments, star tracker evaluations and calibrations, and the enlarged instrument chamber will provide an in-house capability at MSFC for performing thermal vacuum tests on payloads flown in the Shuttle cargo bay.

IMPACT OF DELAY:

The modified XRCF is the only facility capable of supporting essential x-ray development testing and calibration of the AXAF spacecraft. This facility must be initiated in FY 1989 to be available for required AXAF system testing. Delay of this facility project will directly delay the AXAF program schedule and increase the program costs.

PROJECT DESCRIPTION:

Modifications to the XRCF include the following:

1. Lengthen the instrument chamber and provide an internal 360° liquid nitrogen (LN_2) cooled shroud to provide a test volume approximately 18-foot-diameter by 50-foot-long to accommodate the AXAF spacecraft. Provide necessary additional pumping systems and other supporting utilities.

2. Increase the size of the instrument chamber building to accommodate the requirements in item 1 above. The existing class 10,000 clean room will be enlarged accordingly and will be equipped with an air-lock entrance on the south side of sufficient size to provide transfer clearance for any test hardware which fits the enlarged instrument chamber. This enlarged building will also provide space for a new control room on the south side of the instrument chamber.

3. Relocate the existing 1,000 feet of 3-foot-diameter guide tube 700 feet to the west. Insert an additional 400 feet of 5-foot-diameter and 300 feet of 4-foot-diameter guide tube between the instrument chamber and the relocated 3-foot-diameter guide tube section for a total length of 1,700 feet. The centerline of the guide tube will be lowered to accommodate the test article. New vacuum pumping systems and support utilities for the extended guide tube will be provided.

4. Provide a new x-ray source building at the west end of the guide tube and relocate the existing x-ray source and alignment source to that building.

5. Provide new control consoles and equipment for the enlarged facilities and install them in the new control room to be located in the instrument chamber building. Relocate existing instrumentation equipment to Building 4708.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	I0,070,000
Site Work	LS	---	---	190,000
Instrument Chamber Building.	LS	---	---	3,550,000
Instrument Chamber.....	LS	---	---	1,230,000
Clean Room	LS	---	---	1,130,000
Source Chamber Building.....	LS	---	---	1,110,000
Guide Tubes and Supports	LS	---	---	1,600,000
Pumps and Equipment.....	LS	---	---	890,000
Power/Lighting/Fire Alarms	LS	---	---	370,000
Equipment.....	---	---	---	1,330,000
Fallout Shelter (not feasible)..	---	---	---	---
Total				11,400,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Layout of XRCF Facility

OTHER EQUIPMENT SUMMARY:

Equipment to be funded with R&D resources will consist of an optical bench and associated electrical/mechanical fixtures with an estimated cost of $6,000,000.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF resources are required to complete the present scope of this project.

MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1989 ESTIMATES
MODIFICATIONS TO THE X-RAY CALIBRATION FACILITY (XRCF), BUILDING 4708
LOCATION PLAN

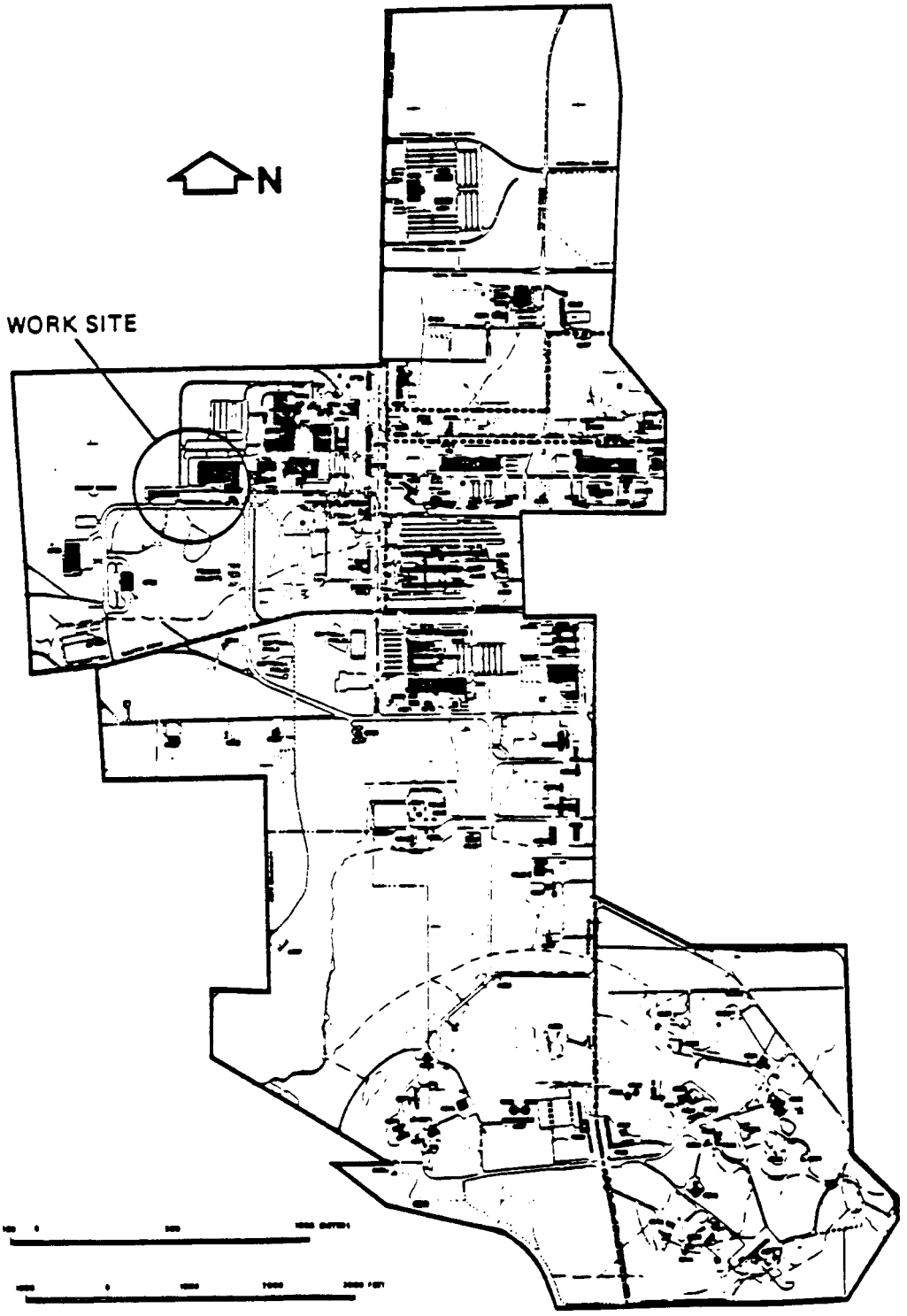


FIGURE 1

MARSHALL SPACE FLIGHT CENTER
FISCAL YEAR 1989 ESTIMATES
MODIFICATIONS TO THE X-RAY CALIBRATION
FACILITY (XRCF), BUILDING 4708

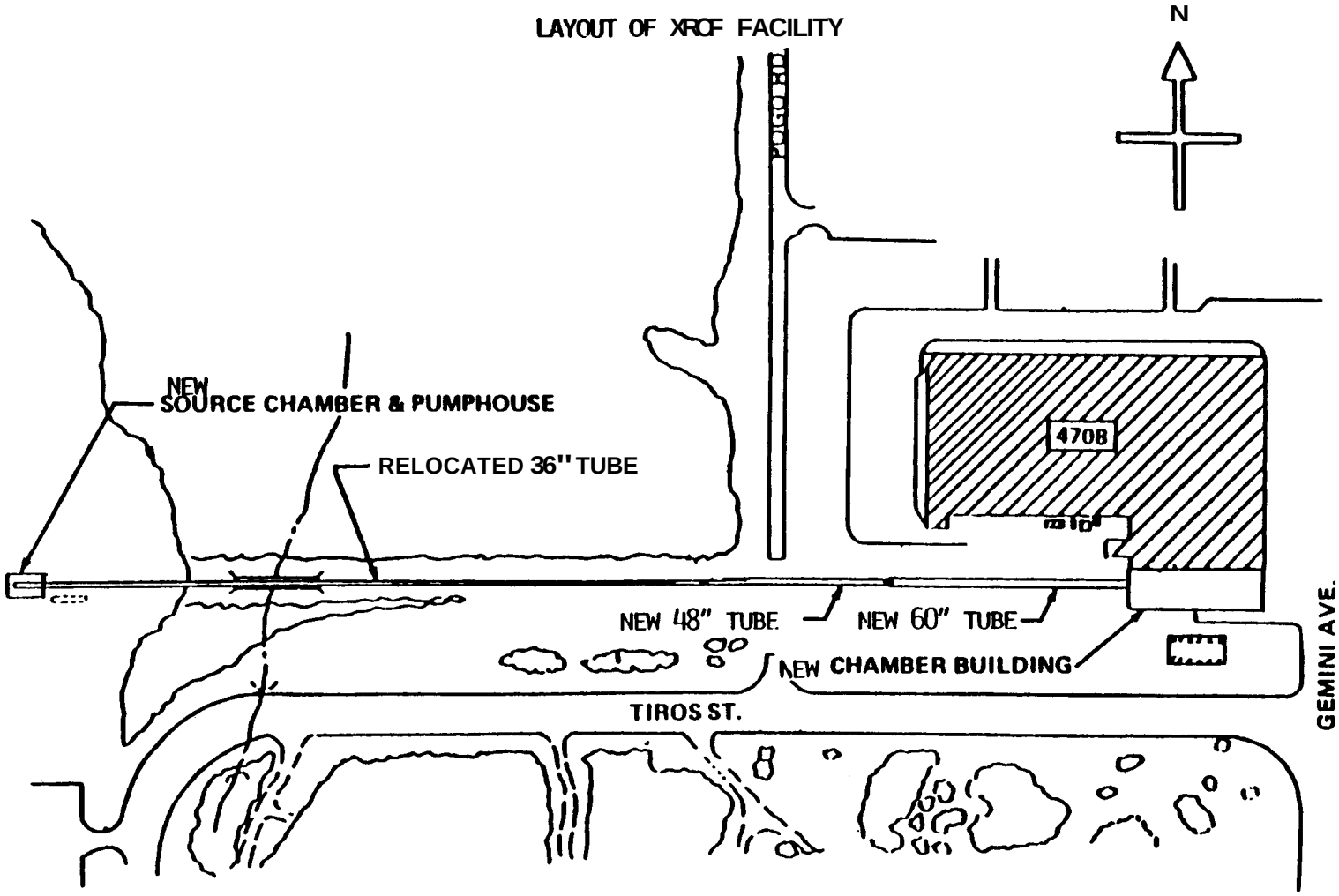


FIGURE 2

GODDARD
SPACE FLIGHT CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

GODDARD SPACE FLIGHT CENTER

	Amount	Page No.
Office of Space Science and Applications:		
Modernization of Space Environment Simulator	2,800,000	CF 5-1
Modifications for Utility Reliability	3,100,000	CF 5-9
Total	5,900,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Modernization of Space Environment Simulator

INSTALLATION: Goddard Space Flight Center

FY 1989 CoF Estimate: $2,800,000

LOCATION OF PROJECT: Greenbelt, Prince George's County, Maryland

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science and Applications

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	$206,000	$ ---	$ 206,000
Capitalized Investment.....	--	5,599,902	5,599,902
Total.....	$206.000	$5,599,902	$5,805,902

SUMMARY PURPOSE AND SCOPE:

This project provides for modernizing the Space Environment Simulator (SES) located in Building 10 (Figures 1 and 2) by upgrading the vacuum pumping system from oil diffusion to cryogenic vacuum pumps. This will eliminate the risk of oil contamination of payloads during testing. For the last 25 years, the SES has been a key element in the Goddard spacecraft development capability and must be modernized to meet the testing needs of spacecraft being developed and planned for the future.

PROJECT JUSTIFICATION:

The SES is a 27-foot by 40-foot thermal vacuum chamber (Figure 3) used for systems-level thermal testing of both engineering and flight hardware. The current pumping system is 25 years old and uses 17 oil diffusion pumps to attain high vacuum. These pumps pose an inherent risk of oil backstreaming into the chamber test space. Contamination of the vacuum chamber by diffusion pump oil degrades instrument sensitivity particularly in the ultraviolet spectral ranges. Contamination of optical surfaces is difficult to clean because cleaning methods tend to further degrade the optical surfaces. There have been several incidents where diffusion pump oil has backstreamed into the chamber onto flight hardware. Newer types of spacecraft contain significantly more sensitive instruments than those of older spacecraft and these newer instruments are extremely sensitive to air contamination. Presently, testing must be compromised by not including contamination-sensitive instruments during the system thermal test. The proposed modification would eliminate this risk and the risks and costs of otherwise unnecessary disassembly and reassembly of spacecraft by replacing the obsolete diffusion pumps with state-of-the-art cryogenic pumps and a turbomolecular pump (Figure 4). A cryopumped SES will provide a safer, cost-effective test environment for all in-house developed payloads and carriers. The proposed work will modernize this outdated facility and maintain Goddard's hands-on capability to develop advanced payloads and technology, as well as providing an in-house capability for refurbishment of recovered spacecraft.

IMPACT OF DELAY:

Delay of this project would adversely affect the utilization of the chamber by contamination-sensitive payloads instruments. If funded in FY 1989, the upgraded chamber would be used for the testing of the contamination-sensitive Extreme Ultraviolet Explorer (EUVE) and the Flight Support System - Upper Atmosphere Research Satellite (UARS) configuration.

PROJECT DESCRIPTION:

This project provides for the replacement of the existing diffusion pumping system with a cryogenic vacuum pumping system. Proposed work for this project includes the replacement of seventeen 32-inch oil diffusion pumps with eight 48-inch cryogenic pumps of equal or greater volumetric capacity so as to maintain the 1×10^{-6} torr operating level of the simulator. Two mechanical pumps will be provided for initial stage roughing of cryopumps. A turbomolecular pump with its dedicated mechanical roughing pump will be included to handle non-condensed gases such as helium and hydrogen. Related work will include the addition of vacuum

valves for the new cryopumps; alterations to foreline, compressed air, LN_2, GN_2, and cooling water systems; installation of new motor controls, and installation of other ancillary systems/components required to accommodate the new equipment.

Existing controls and instrumentation of the vacuum system will be upgraded/consolidated/replaced and brought to the state-of-the-art condition. Steam cleaning of the chamber interior and evacuating lines will be performed to remove all residual oil deposits.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	Total Cost
Land Acquisition	---	---	---	$ ---
Construction	---	---	---	2,800,000
- Demolition	LS	---	---	175,000
- 48" Cryopumps	EA	8	107,500	860,000
- 48" Gate Valves	EA	8	102,500	820,000
- Turbomolecular Pump	EA	1	90,000	90,000
- Controls/Instrumentation	LS	---	---	730,000
- Chamber Cleaning	LS	---	---	125,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				$2,800,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Buildings 7/10/15/29 Complex
Figure 3 - 27' x 40' Space Environment Simulator (SES) Vacuum Chamber
Figure 4 - Comparison of New Pumping versus Old Pumping System

OTHER EQUIPMENT SUMMARY:

No other equipment is required to complete this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is required to complete this project.

GODDARD SPACE FLIGHT CEN
FISCAL YEAR 1989 ESTIMA'
HODERNIZATION OF SPACE ENVIRONMENT SIHULATOR

LOCATION PLAN

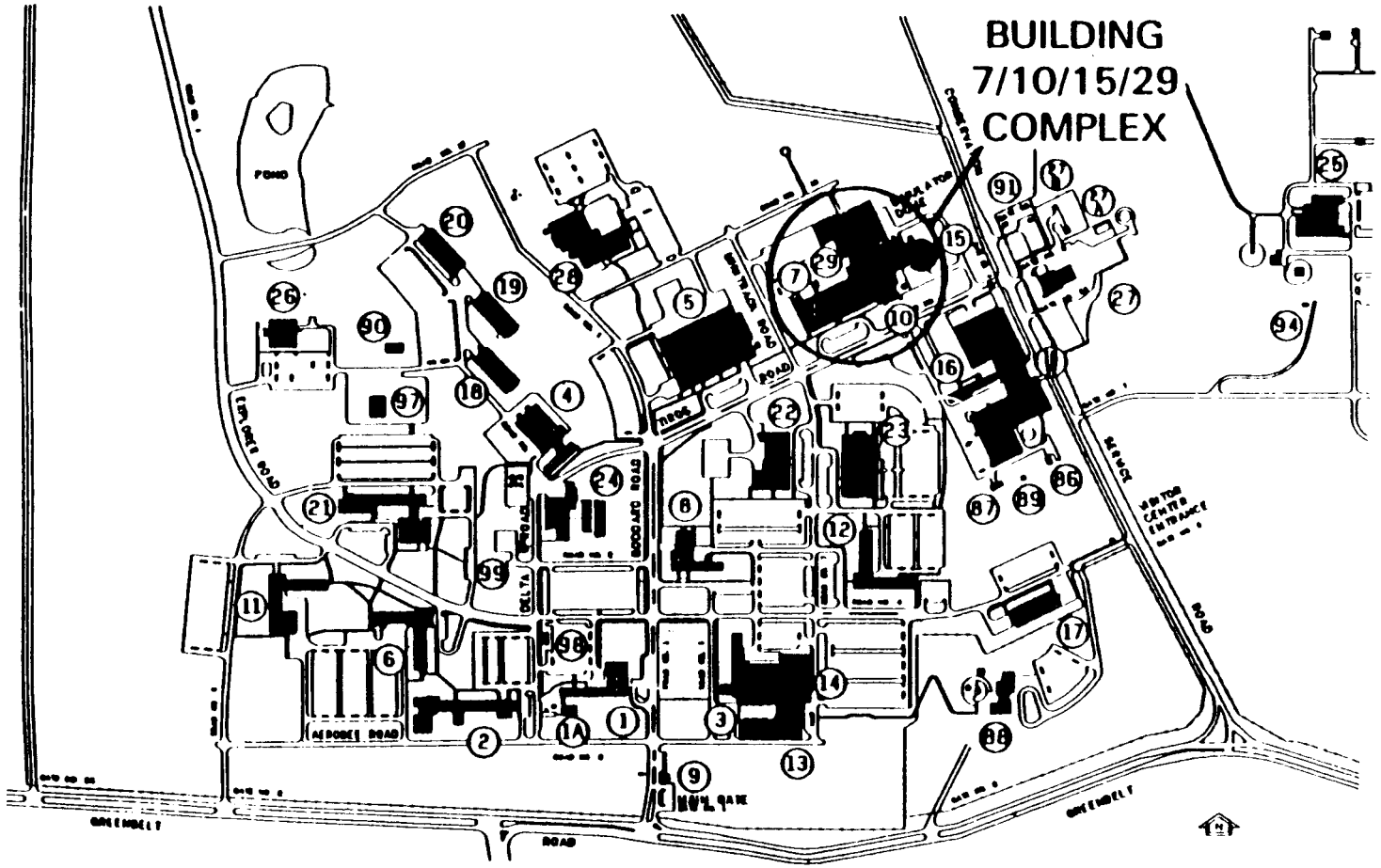


FIGURE 1

CODDARD SPACE FLIGHT CENTER
FISCAL TEAR 1989 ESTIMATES
MODERNIZATION OF SPACE ENVIRONMENT SIMULATOR

BUILDING 7/10/15/29 COMPLEX

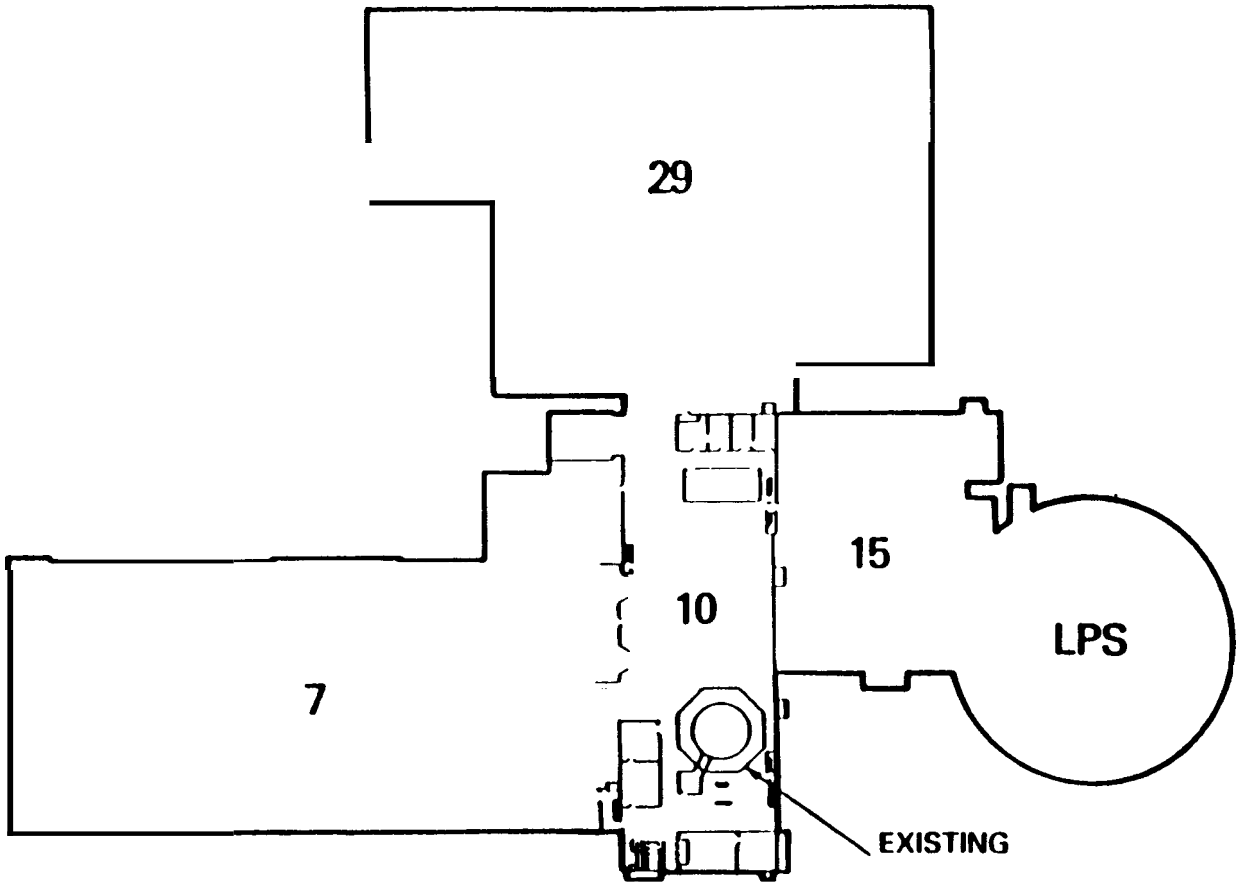


FIGURE 2

CODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1989 ESTIMATES
MODERNIZATION OF SPACE ENVIRONMENT SIMULATOR

27' X 40' SPACE ENVIRONMENT SIMULATOR
(SES) VACUUM CHAMBER

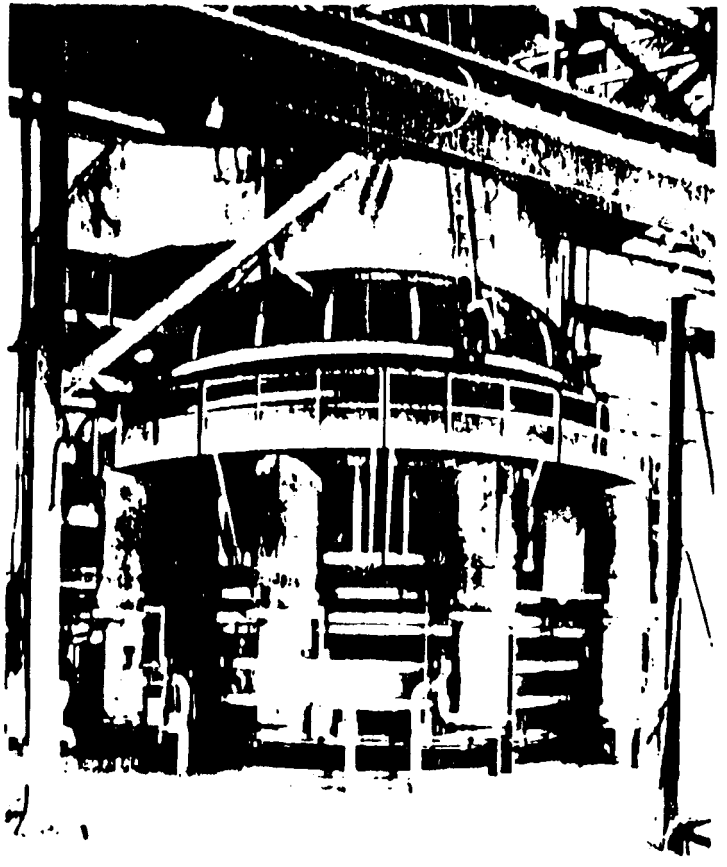


FIGURE 3

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1989 ESTIMATES
MODERNIZATION OF SPACE ENVIRONMENT SIMULATOR

COMPARISON OF OLD PUMPING VERSUS NEW PUMPING SYSTEM

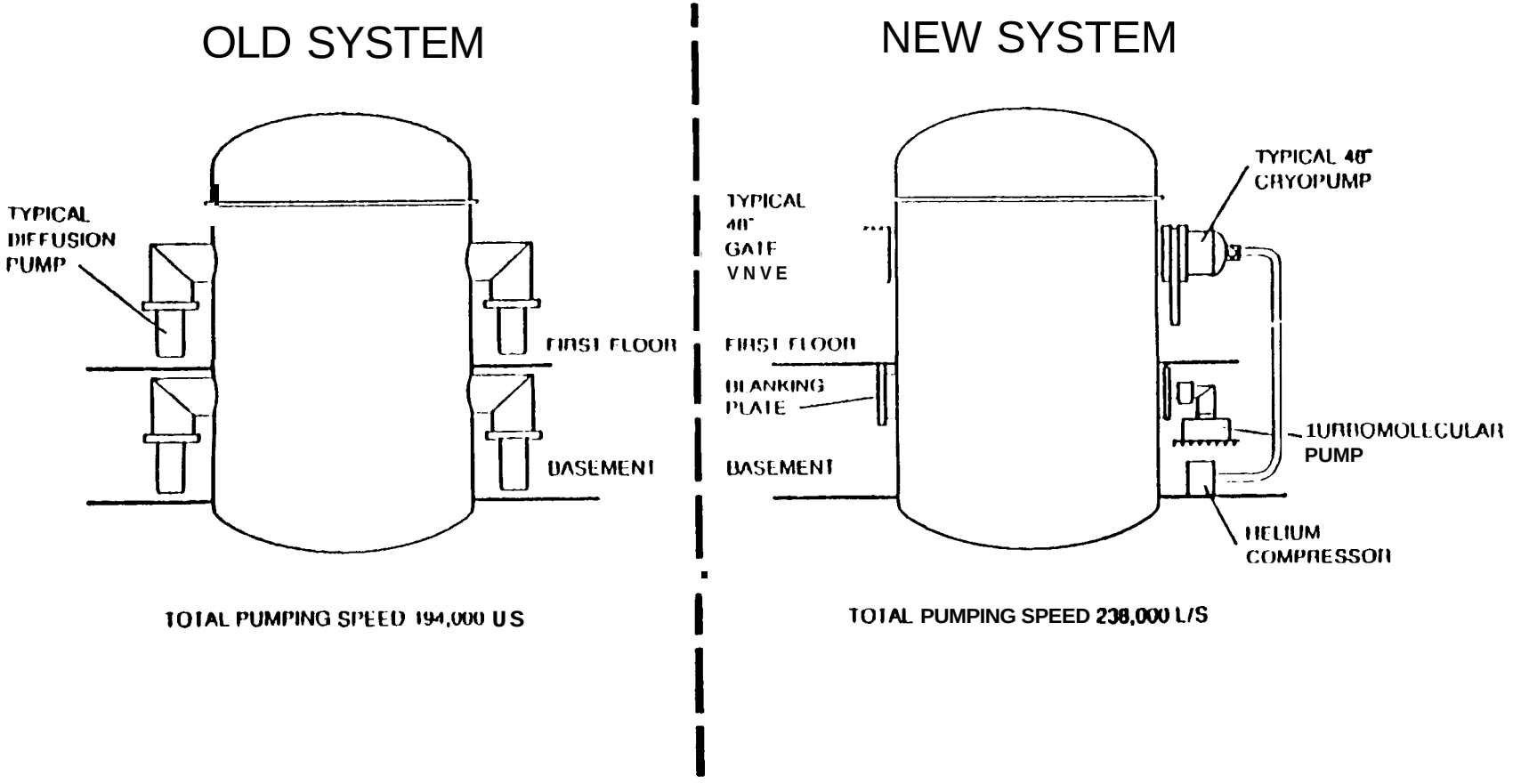


FIGURE 4

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Modifications for Utility Reliability

INSTALLATION: Goddard Space Flight Center

FY 1989 CoF Estimates: $3,100,000

LOCATION OF PROJECT: Greenbelt, Prince George's County, Maryland

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science and Applications

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF funding..	$240,000	---	$240,000
Capitalized investment.....	---	---	---
Total.....	$240,000	---	$240,000

SUMMARY PURPOSE AND SCOPE:

This project provides for increased reliability of the Goddard Space Flight Center (GSFC) chilled water and electrical distribution systems which support communications and control of the Tracking and Data Relay Satellite System, Shuttle flights, major science and application satellites and DOD missions. The present system provides emergency backup electrical power for critical equipment but no backup for cooling of the same equipment. The result is that a short-term electrical failure shuts down the electronic equipment because of overheating even though a limited amount of emergency electrical power is still available. This project will provide short-term backup for the cooling systems to allow the safing of satellites and the orderly shutdown of control and communication equipment.

PROJECT JUSTIFICATION:

A major mission of the GSFC is to provide tracking, data acquisition, and control of Earth orbiting spacecraft, and warehousing, and distribution of technical data. With the advent of manned spacecraft the control and communication functions increased extensively. For the Mercury, Gemini, and Apollo Missions, all data on the condition of the men and machines had to be analyzed in real time and the data flow from the applications spacecraft (communications, weather, etc.) further increased the demand for real-time receiving and processing. In the Tracking and Data Relay Satellite System (TDRSS), and Space Shuttle era, the demands on the system have again taken a significant increase causing the GSFC communications and control complex to operate 24 hours a day. This operation has become extremely critical to TDRSS support of major satellite, Shuttle flights, and certain DOD payloads.

In order to keep pace with the rise in demand for services, new computers and communications equipment have been added or have replaced older models. Facilities to support this equipment have also been constructed. This includes chillers for increased chilled water distribution necessary to cool the electronic equipment. Secondary (or backup) utility systems especially for cooling were not included. No additional backup diesel generators have been added since 1965. The result is that no backup power capability to fully operate the existing cooling system during electrical power shortages is not adequate. While commercial power is normally reliable, the present air-conditioning system is essentially disabled by short power interruption. While critical electronic equipment is supported by uninterruptable power supplies (UPS) for 15 minutes, without cooling, computer spaces overheat and require operating equipment to be shut down within 5 minutes after the electric power fails. It is essentially impossible to put all electronic and computer equipment and spacecraft into a "safe" mode within these 5 minutes and this causes abrupt cessation of satellite control and data handling. A reliability study of GSFC utilities indicates commercial power outage of more than 15 minutes are much less likely than short interruptions. By providing uninterrupted air-conditioning support for at least 15 minutes, this project will provide adequate protection against short-term failures which are the most likely to occur.

IMPACT OF DELAY:

With the advent of the TDRSS and the probability of multiple Space Transportation System (STS) flights each year, the critical areas of GSFC will be in mission status on a continuous basis. Delay of this project will extend the risk that a minor power failure will disable the Center's chilled water system and cause an abrupt shutdown of mission support control and communications.

PROJECT DESCRIPTION:

Small emergency power plants will be provided to operate chilled water pumps, critical air handlers, booster pumps and controls. A 500kW diesel, now excess to the Ground Tracking System will be located near Building 24 and a battery backup system will be located at the 3/13/14 complex to provide electrical power for operation of the chilled water system for at least 15 minutes. Automatic valves also will be installed in the chilled

water distribution system for isolation of critical areas. Controls for this system will be located in the power house: A 100,000-gallon chilled water reservoir will be constructed to provide 15-minute (minimum) cooling.

PROJECT COST ESTIMATE:

This project cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	$3,100,000
Emergency power system	LS	---	---	*2,020,000*
Site Work	LS	---	---	65,000
Building 24 Modifications	LS	---	---	370,000
Architectural/structural	LS	---	---	(195,000)
Mechanical	LS	---	---	(90,000)
Electrical	LS	---	---	(85,000)
Chilled Water Storage System	LS	---	---	645,000
Equipment	---	---	---	---
Fallout Shelter (not required)	---	---	---	---
Total				$3,100,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan - Chilled Water Distribution System Modifications
Figure 2 - Chilled Water Storage

OTHER EQUIPMENT SUMMARY:

Equipment will be relocated, but no new equipment is anticipated.

FUTURE CoF ESTIMATED FUNDING REQUESTED TO COMPLETE THIS PROJECT:

No future CoF funding is required to complete this project.

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1989 ESTIMATES
MODIFICATIONS FOR [redacted] RELIABILITY

LOCATION PLAN

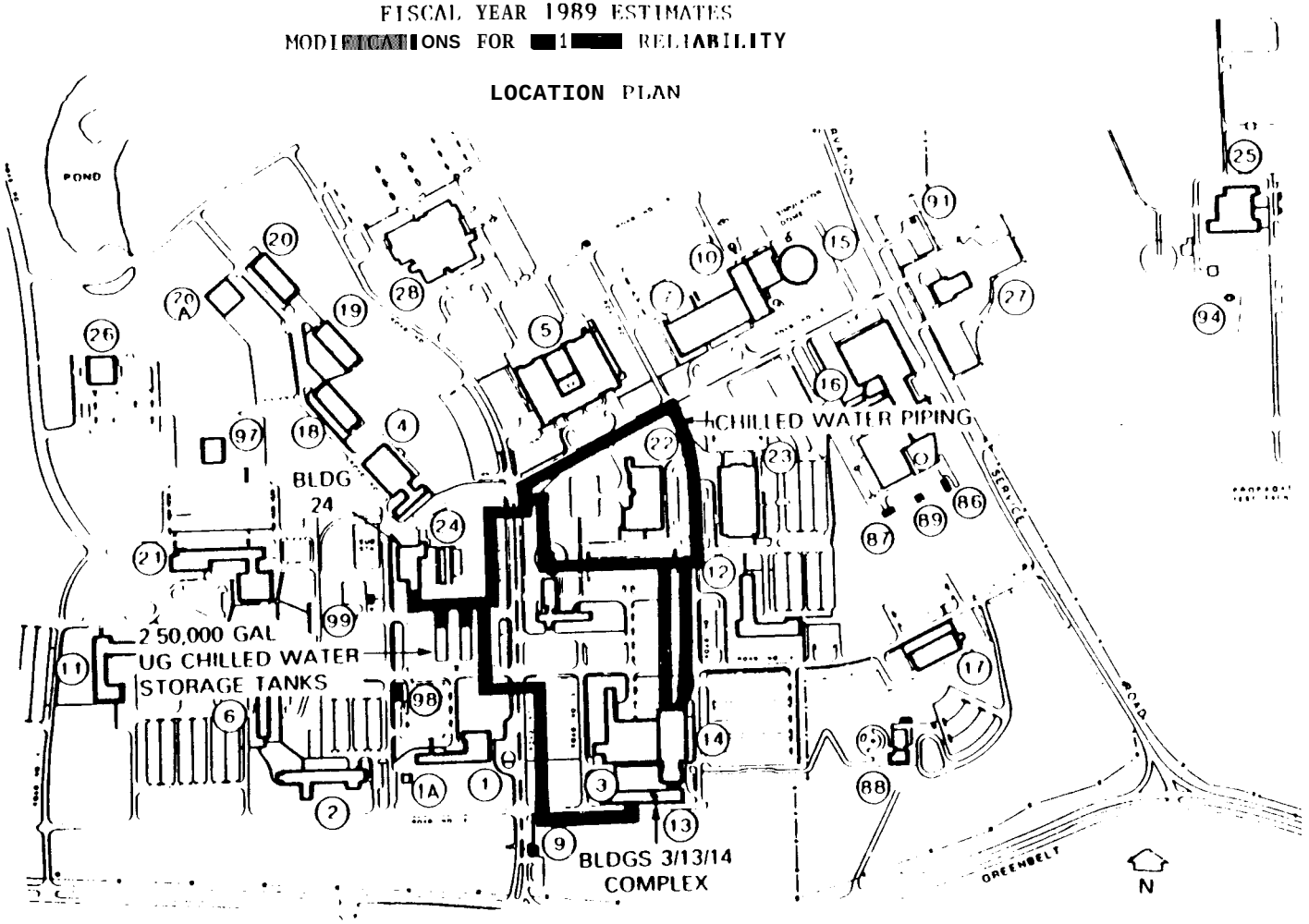


FIGURE 1

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1989 ESTIMATES
MODIFICATIONS FOR UTILITY RELIABILITY

CHILLED WATER STORAGE

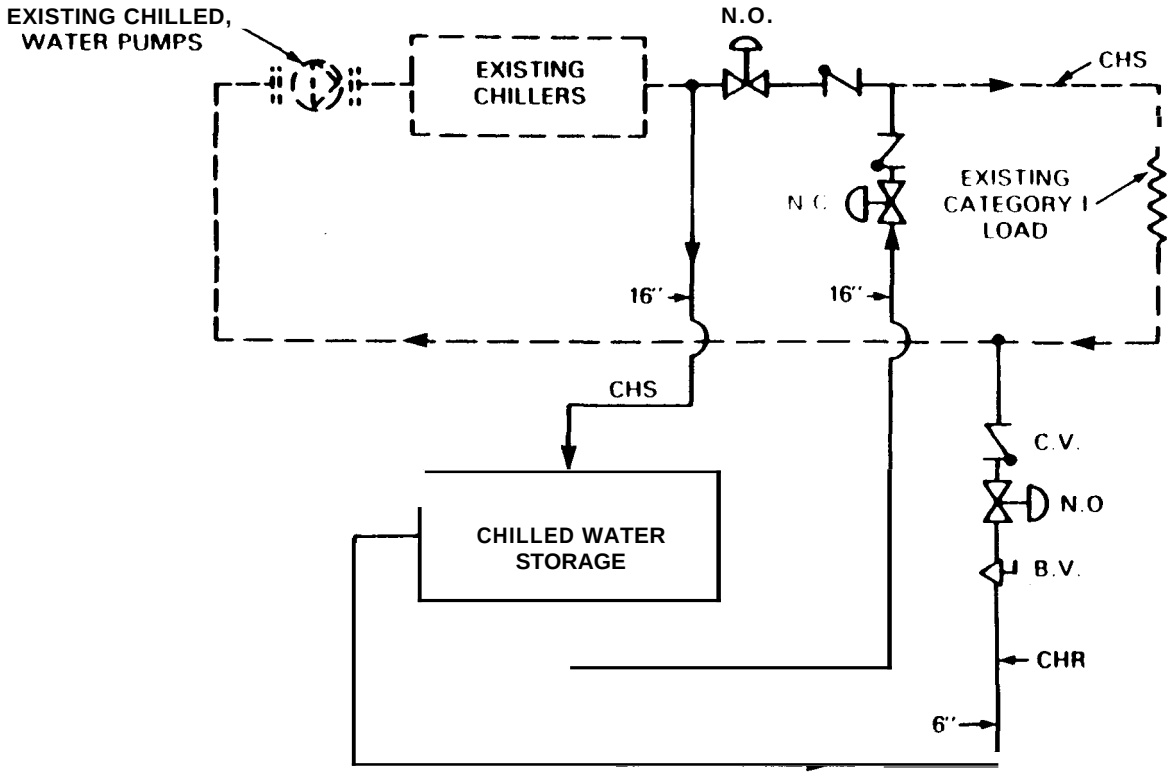


FIGURE 2

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

JET PROPULSION LABORATORY

	Amount	Page No.
Office of Space Science and Applications:		
Refurbishment of 25-Foot Space Simulator.....	12,000,000	CF 6-1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Refurbishment of 25-Foot Space Simulator

INSTALLATION: Jet Propulsion Laboratory

FY 1989 CoF Estimate: $12,000,000

LOCATION OF PROJECT: La Canada-Flintridge, Los Angeles County, California

COGNIZANT HEADQUARTERS OFFICE: Office of Space Science and Applications

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	$863,000	$ -0-	$ 863,000
Capitalized Investment.....	N/A	1,823,497	1,823,497
Total.....	$863,000	$1,823,497	$2,686,497

SUMMARY PURPOSE AND SCOPE:

This project will refurbish the 25-foot Space Simulator, Building 150, by resurfacing the 23-foot diameter solar simulator collimating mirror, replacing the existing power supply rectifiers of the solar simulation system, and replacing the obsolete oil diffusion pumps with new cryogenic pumps. The space simulator chamber has been used on each of the JPL major flight projects such as the Mariners, Viking, Voyager, IRAS and Galileo. Without these modifications, JPL will lose this vital space simulator test capability for future flight projects.

PROJECT JUSTIFICATION:

The collimating mirror is the largest optical element of the solar simulator system, and was fabricated in 1965. Each major JPL flight project such as the Mariners, Viking, Voyager, IRAS, and Galileo used this mirror's test capability. Future planetary exploration projects will also utilize its test capability. The condition of the mirror's nickel substrat has deteriorated over the years so that the specified test intensity of the solar beam cannot be maintained. The mirror surface has deteriorated to where the reflectivity is less than 50 percent. Some isolated areas are currently producing only 12-percent reflectance. Corrosion pits and bubbles have appeared across the entire nickel surface. This condition now requires full power of all solar lamps for each test. The original simulator's capability of 2.0 solar constants intensity has deteriorated to only 1.0 solar constants. If this deterioration is allowed to continue, the chamber will become inoperable and future flight projects cannot be tested.

The current solar simulation system consists of 37 30Kw-lamp assemblies using 111 power rectifiers that were purchased in 1961. These rectifiers are experiencing mechanical and electrical component failures at an increasing rate. Replacement parts are no longer available, and parts salvaged from other units have been used to maintain operation. Continuance of this practice will shortly not be feasible.

The 25-foot Space Simulator is the principal test facility for NASA/JPL planetry exploration flight project environmental testing at the system level. It uses obsolete oil diffusion pumps for pressure reduction which have a very high probability of contaminating optical instruments with oil particles during a test. Because of this, optical instruments must be shielded or removed prior to placement of spacecraft in the chamber. This project will replace the contaminating oil diffusion pumps with the cleaner and more efficient cryopumps that will correct the problem and keep optical and sensor elements clean during vacuum operation.

IMPACT OF DELAY:

Delay of this project will further reduce the capability of the space simulator to a point where acceptable light uniformity and intensity cannot be produced and future flight projects cannot be tested prior to launch.

PROJECT DESCRIPTION:

This project will refurbish the 25-foot Space Simulator, Building 150, by resurfacing the 23-foot diameter solar simulator collimating mirror, replacing the existing power supply rectifiers of the solar simulation system, converting the oil diffusion pumping system to a new cryogenic and turbo-molecular system and updating the corresponding section of the central console.

The 23-foot diameter mirror will be removed from the space simulator chamber. The reflective aluminum, and electrolytic nickel supporting surfaces will be stripped off, the surface of the mirror will be reground by a specially fabricated machine, then plated with electroless nickel and polished, After the mirror is reinstalled in the simulator chamber, the surface will be aluminized.

The deteriorating power supply rectifiers of the solar simulation system will be replaced with new high-efficiency rectifiers. Approximately 111 old rectifiers serving 37 existing lamp assemblies will be replaced with 37 individual rectifiers (plus spares). The existing electrical control and power distribution systems will also be modified and updated to suit the new rectifiers' requirements as well as to meet stricter specifications for spacecraft testing.

This project also proposes to replace all ten oil diffusion pumps of the space simulator chamber with ten new cryogenic pumps installed in existing ports. Two new turbo pumps will also be installed to provide pumping of helium, hydrogen, and the lighter gases. This work will also include all of the necessary nitrogen piping, insulation, structural, and electrical modifications, including reworking the existing pressure/temperature instrumentation and control board, to accommodate the new cryopump requirements.

The present housing over the diffusion pumps will be enlarged and heightened to permit installation, containment, and maintenance of the new pumps and cryogenic elements that will be installed in this area.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	Total cost
Land Acquisition	---	---	---	-0-
Construction	---	---	---	12.000.000
Modify Lamp Power Supply	LS	---	---	1,830,000
Resurface Mirror	LS	---	---	4,420,000
Modify Vacuum Pumping System	LS	---	---	5,750,000
Equipment	---	---	---	-0-
Total				$12,000,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Schematic Section

OTHER EQUIPMENT SUMMARY:

No other equipment is required to complete this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

There is no future funding required to complete this project.

JET PROPULSION LABORATORY
FISCAL YEAR 1989 ESTIMATES
REFURBISHMENT OF 25-FOOT SPACE SIHULATOR
LOCATION PLAN

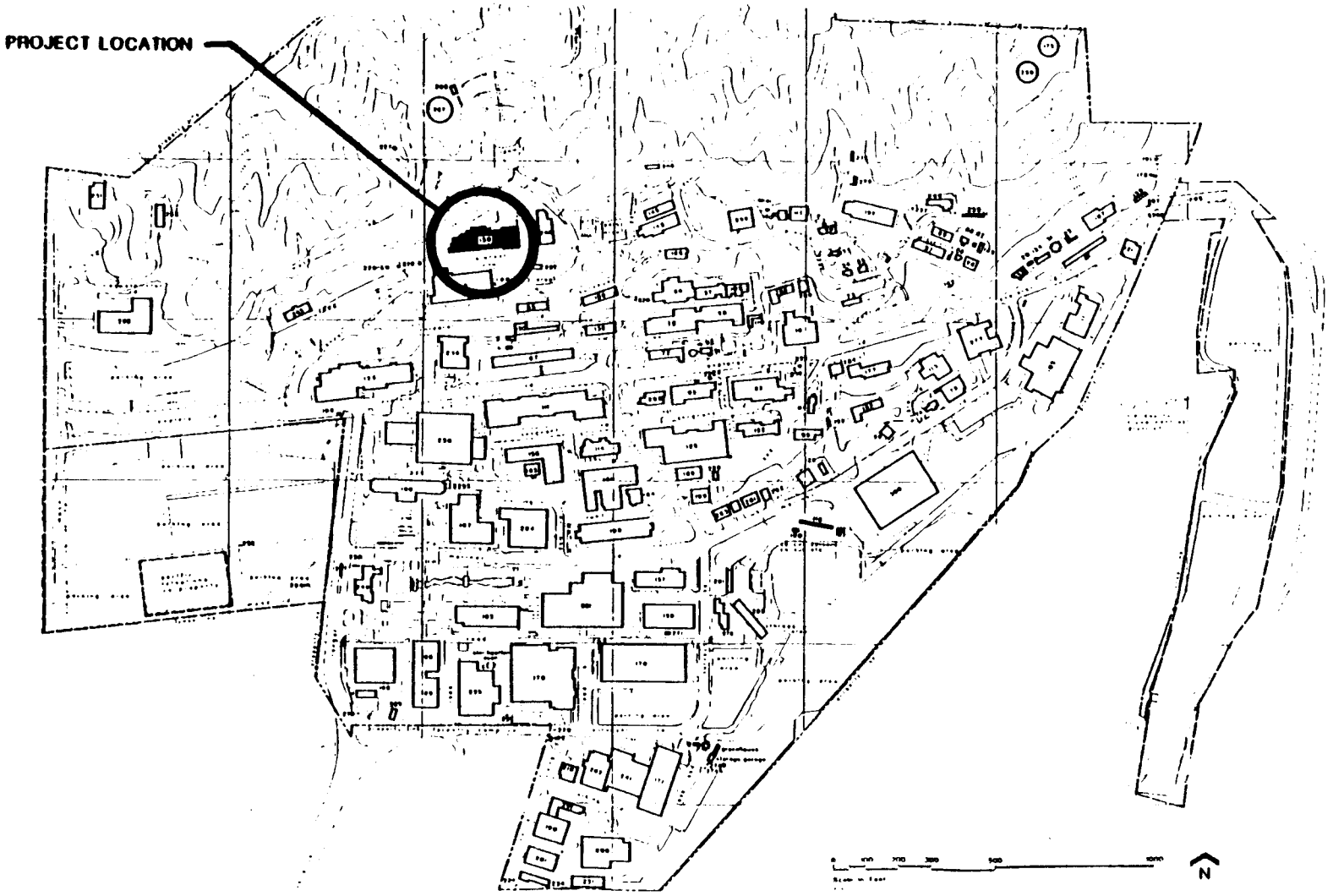


FIGURE 1

JET PROPULSION LABORATORY
FISCAL YEAR 1989 ESTIMATES
REFURBISHMENT OF 25-FOOT SPACE SIMULATOR
LOCATION PLAN

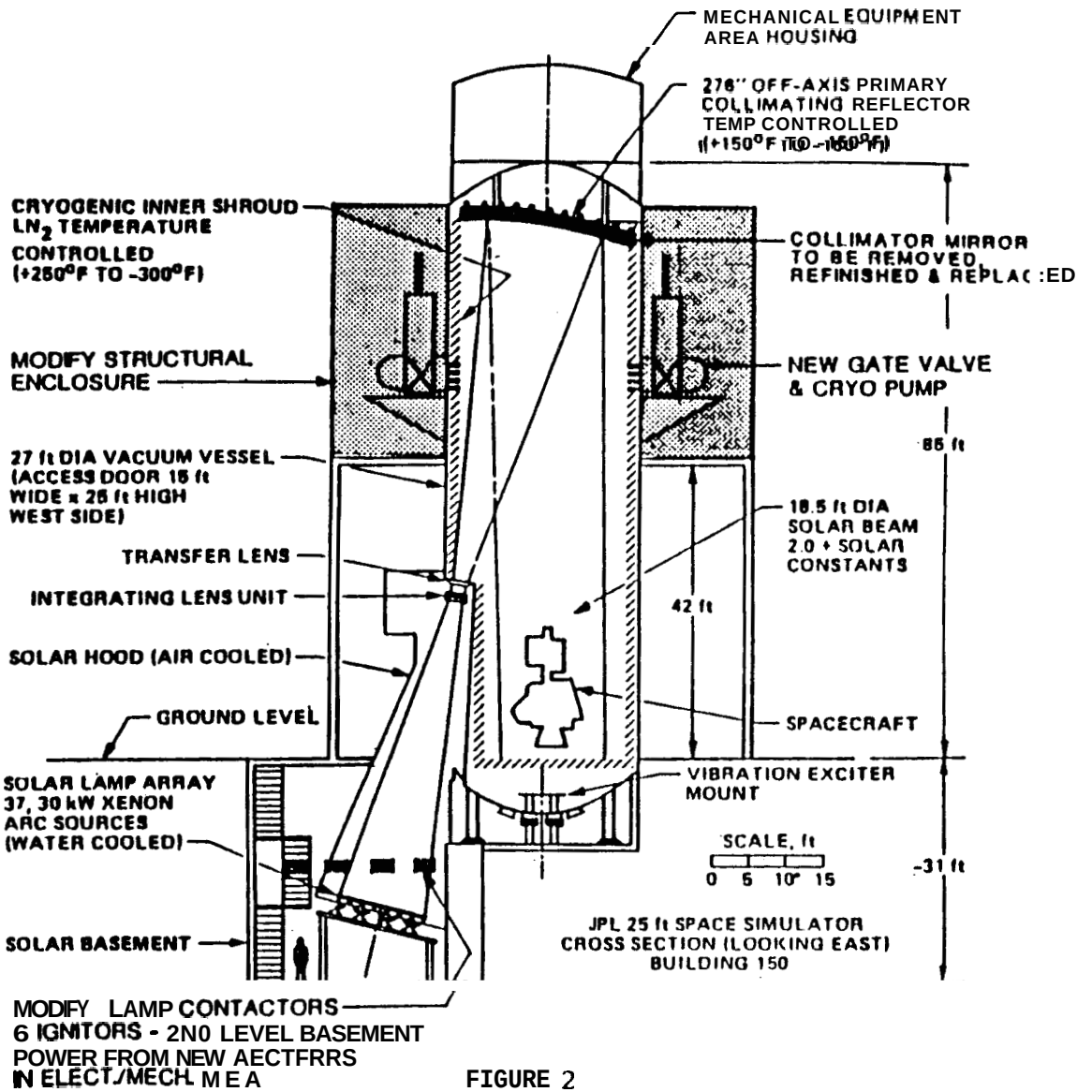


FIGURE 2

AERONAUTICAL
FACILITIES
REVITALIZATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

AERONAUTICAL FACILITIES REVITALIZATION

	Amount	Page No.
Office of Aeronautics and Space Technology:		
Repair and Modernization of the 12-Foot Pressure Wind Tunnel, Ames Research Center	36,500,000	CP 7-1
Rehabilitation and Modifications to 10X10 Supersonic Wind Tunnel, Lewis Research Center	14,500,000	CP 7-9
Refurbishment of Hypersonic Facilities Complex, Langley Research Center	12,800,000	CP 7-17
Total	63,800,000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Repair and Modernization of the 12-Foot Pressure Wind Tunnel

INSTALLATION: Ames Research Center

FY 1989 CoF Estimate: $36,500,000

LOCATION OF PROJECT: Moffett Field, Santa Clara County, California

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	$8,466,000	$10,914,000	$19,380,000
Capitalized Investment.....	N/A	4,828,479	4,828,479
Total.....	$8,466,000	$15,742,479	$24,208,479

SUMMARY PURPOSE AND SCOPE:

This project provides the initial construction increment for the repair and modernization of the 12-Foot Pressure Wind Tunnel. The total project will return the tunnel to its original operating capability of six atmospheres, and upgrade the facility to modern standards for increased reliability and productivity. The facility is required to support the Nation's rapidly expanding requirements for low speed, low turbulence level, high quality flow, and high Reynolds Number aeronautics testing. This increment of construction includes the replacement of the pressure vessel shell and supports and provides a test section isolation system which will allow model access without depressurization of the tunnel circuit. Additional items of work will be started which will provide new model

supports, modernized controls and automation, new model preparation areas, new tunnel internal airstream cooling, and increased main drive power. A follow-on increment is required in FY 1990.

This major repair and modernization project is the initial project of a comprehensive and concepted Aeronautical Facilities Revitalization Plan that is being implemented to restore and modernize the NASA key facilities that are crucial to maintaining U.S. competitiveness in aeronautical research and development. The total program is being phased over a 5-year timeframe with three major projects included in FY 1989.

PROJECT JUSTIFICATION:

The 12-Foot Pressure Wind Tunnel is a significant subsonic pressure wind tunnel which has provided critical high Reynolds Number test capability to NASA, DoD, and the U.S. aircraft industry since 1946. The tunnel has an exceptionally low free stream turbulence level, high quality flow, wide range of flight regimes, and large test section capability for high fidelity models. Since 1965, essentially every military aircraft and civil transport has been tested in the 12-Foot Pressure Wind Tunnel. The discovery of severe, unrepairable weld defects forced the derating of the tunnel from six to one atmospheres of pressure in September 1986 to preclude the possibility of a catastrophic failure. Without repair of the pressure shell to restore the six atmosphere pressure operation, the 12-Foot Pressure Wind Tunnel cannot be used to provide critical high angle of attack, high lift, and laminar flow data for the development of the Nation's advanced military and commercial aircraft.

The 12-Foot Pressure Wind Tunnel is a high-demand facility with tests typically scheduled 8 to 16 months in advance with two-shifts-per-day operation. During its operation, the productivity was severely limited because the entire tunnel circuit had to be depressurized for model changes or adjustments. In addition, the inability to assemble, check out, and calibrate models outside the test section and the use of outdated and obsolete model support systems and controls severely hampered and limited efficient utilization of the tunnel. The modernization portion of this project will result in a significant increase in productivity with installation of a test section pressure isolation system, a modern measurement and automation system, and dedicated model preparation and calibration areas.

IMPACT OF DELAY:

The current backlog of essential tests will continue to grow if the repair and modernization of this facility is delayed. Many constraints will have to be imposed on important aeronautical research and development that will contribute to further erosion of the U.S. aeronautical competitive position relative to foreign competition and national defense. Some commerical airplane tests may be performed in European test facilities with consequent potential for loss of proprietary data to foreign competitors.

PROJECT DESCRIPTION:

This project provides the initial increment of the repair and modernization of the 12-Foot Pressure Wind Tunnel. It includes the replacement of the pressure shell and support structure, and the installation of a new spherical rotating test section plenum to provide pressure isolation for improved model access. The new shell will be constructed as an ASME code-stamped vessel certified for six atmosphere operation. Additionally, this increment will start the repair and modernization of the following items of work: New model handling systems and supports; main drive power increase from 12,000 hp to 15,000 hp; a new solid state speed control; enhanced Mach Number and Reynolds Number control by modifing the countervane, inlet guide vane and main drive speed controls; and installing a new internal radiator for airstream cooling. The existing air flow cooling system will be replaced, including piping, valves, pumps, cooling tower, and controls. Installation of modern tunnel automation and system controls will be started to provide state-of-the-art feed-back and distributed control of all systems from one central control location. The tunnel support building will be modified to include a second story addition. Two new model preparation rooms will be provided to allow buildup and checkout of models prior to installation in the test section. The existing control room will be modernized to include raised computer flooring, visual access to the model staging area, human factors-engineered control consoles, lighting, power, and air-conditioning as required. A new computer support room, and technical shops with supporting utilities will also be included. Also, the roof of the existing test section building will be raised to accommodate installation of a new 20-ton bridge crane. The follow-on construction phase will complete the above items of work and provide for the Hydrotest and Integrated System tests needed to make the facility operational.

PROJECT COST ESTIMATE:

This cost estimate is based on a preliminary engineering report and an independent cost analysis performed by a professional estimating firm.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	$36,500,000
Shell Replacement	LS	---	---	(16,100,000)
Test Section Isolation	LS	---	---	(5,300,000)
Building Modifications	LS	---	---	(3,200,000)
Internal Cooling System	LS	---	---	(1,800,000)
Drive System Modifications	LS	---	---	(4,800,000)
Model Support Systems	LS	---	---	(1,900,000)
Controls and Automation	LS	---	---	(1,900,000)
Construction Management	LS	---	---	(1,500,000)
Equipment	---	---	---	-0-
Fallout Shelter (not feasible)	---	---	---	-0-
Total				$36,500,000

Note: This cost estimate provides for the FY 1989 increment of the total facility. The estimated construction cost of the project is $63,700,000.

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Site Plan
Figure 3 - Schematic Plan

OTHER EQUIPMENT SUMMARY:

None

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

To complete this project, a follow-on increment will be included in the FY 1990 budget for approximately $16.3 million.

AMES RESEARCH CENTER
FISCAL YEAR 1989 ESTIMATES
REPAIR AND MODERNIZATION OF THE 12-FT PRESSURE WIND TUNNEL

LOCATION PLAN

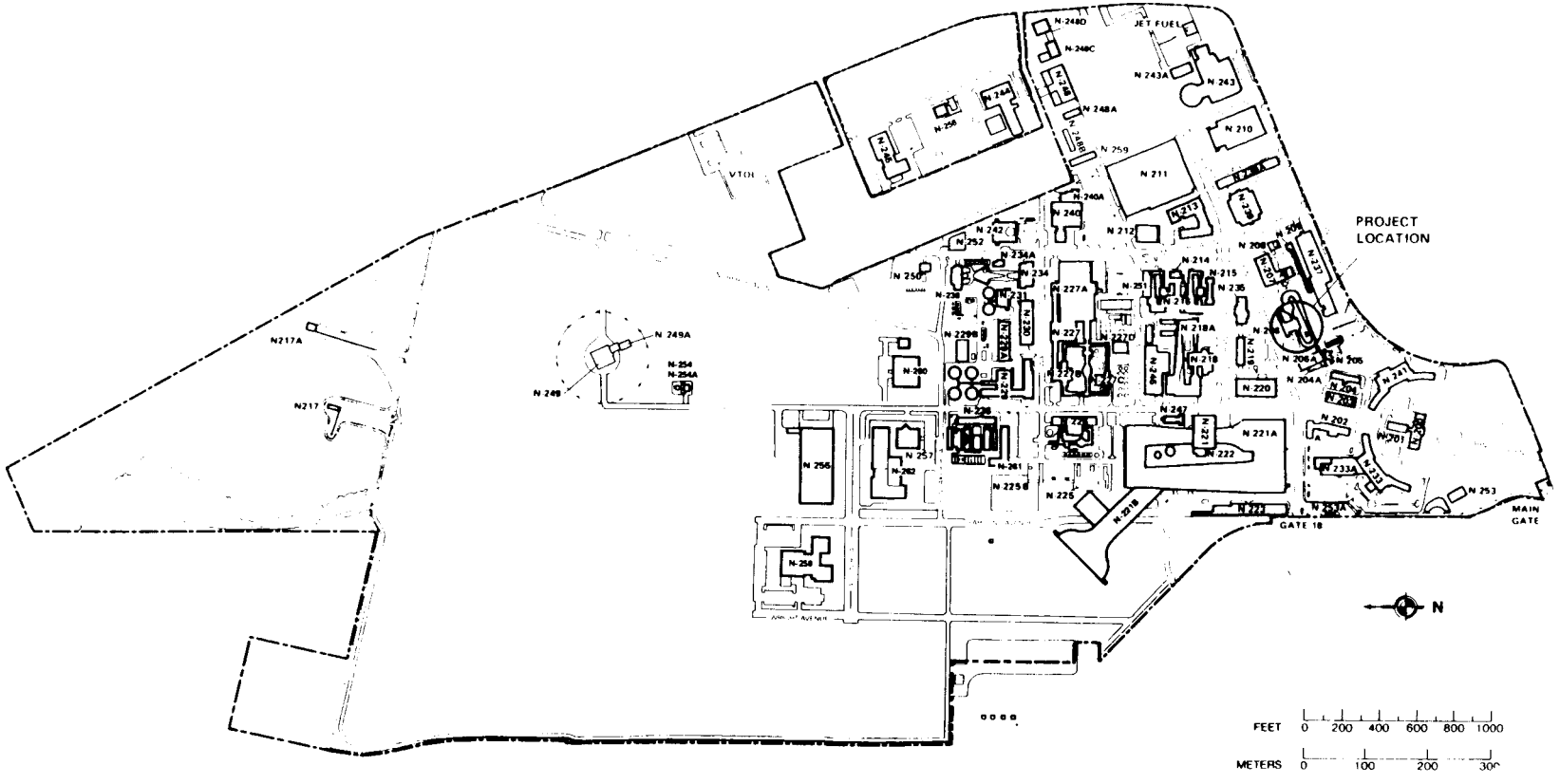


Figure 1

AMES RESEARCH CENTER
FISCAL YEAR 1989 ESTIMATES
REPAIR AND MODERNIZATION OF THE 12-FT PRESSURE WIND TUNNEL

SITE PLAN

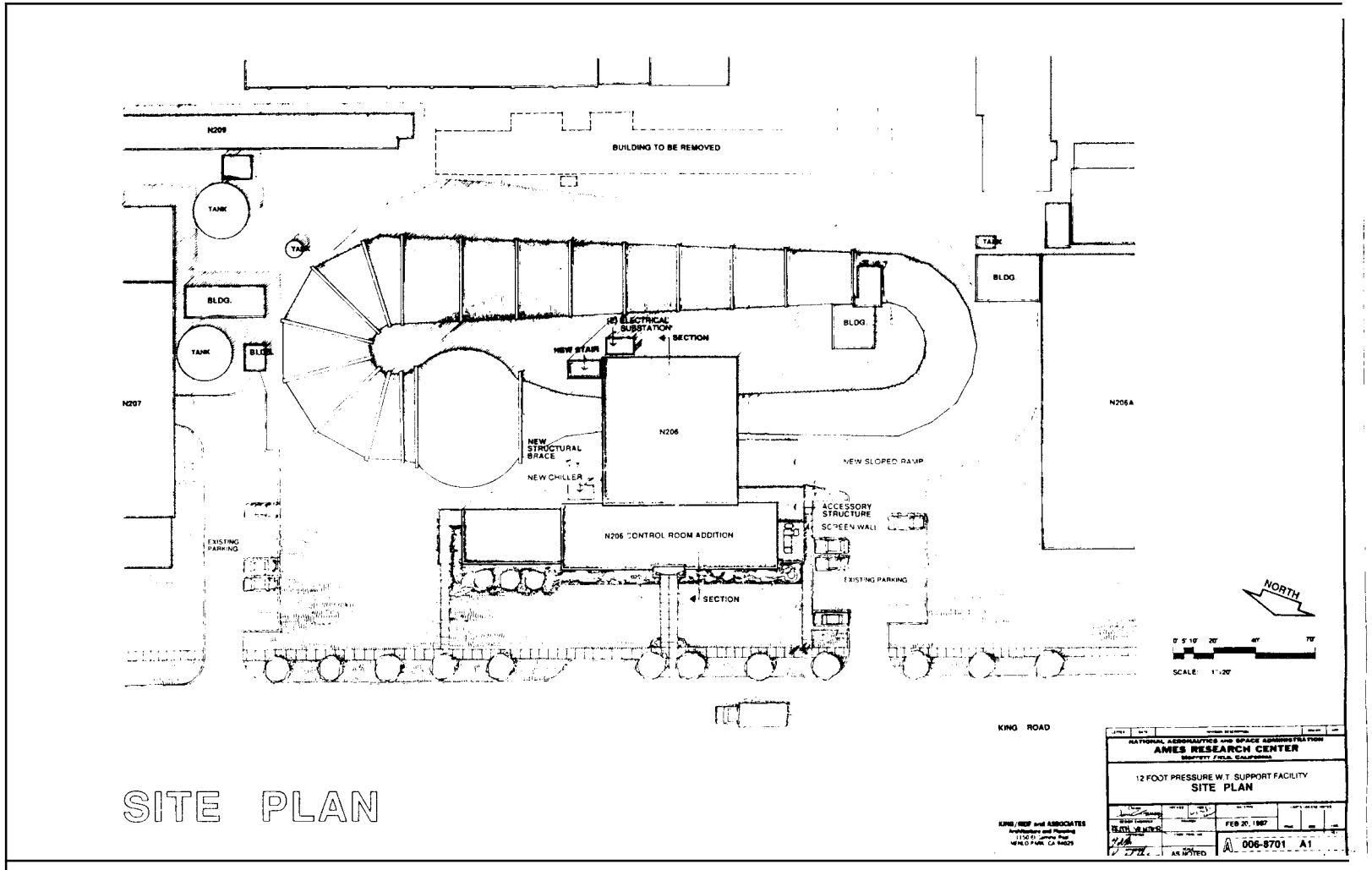


Figure 2

AMES RESEARCH CENTER
FISCAL YEAR 1989 ESTIMATES
REPAIR AND MDERNIZATION OF THE 12-FT PRESSURE WIND TUNNEL

SCHEMATIC PLAN

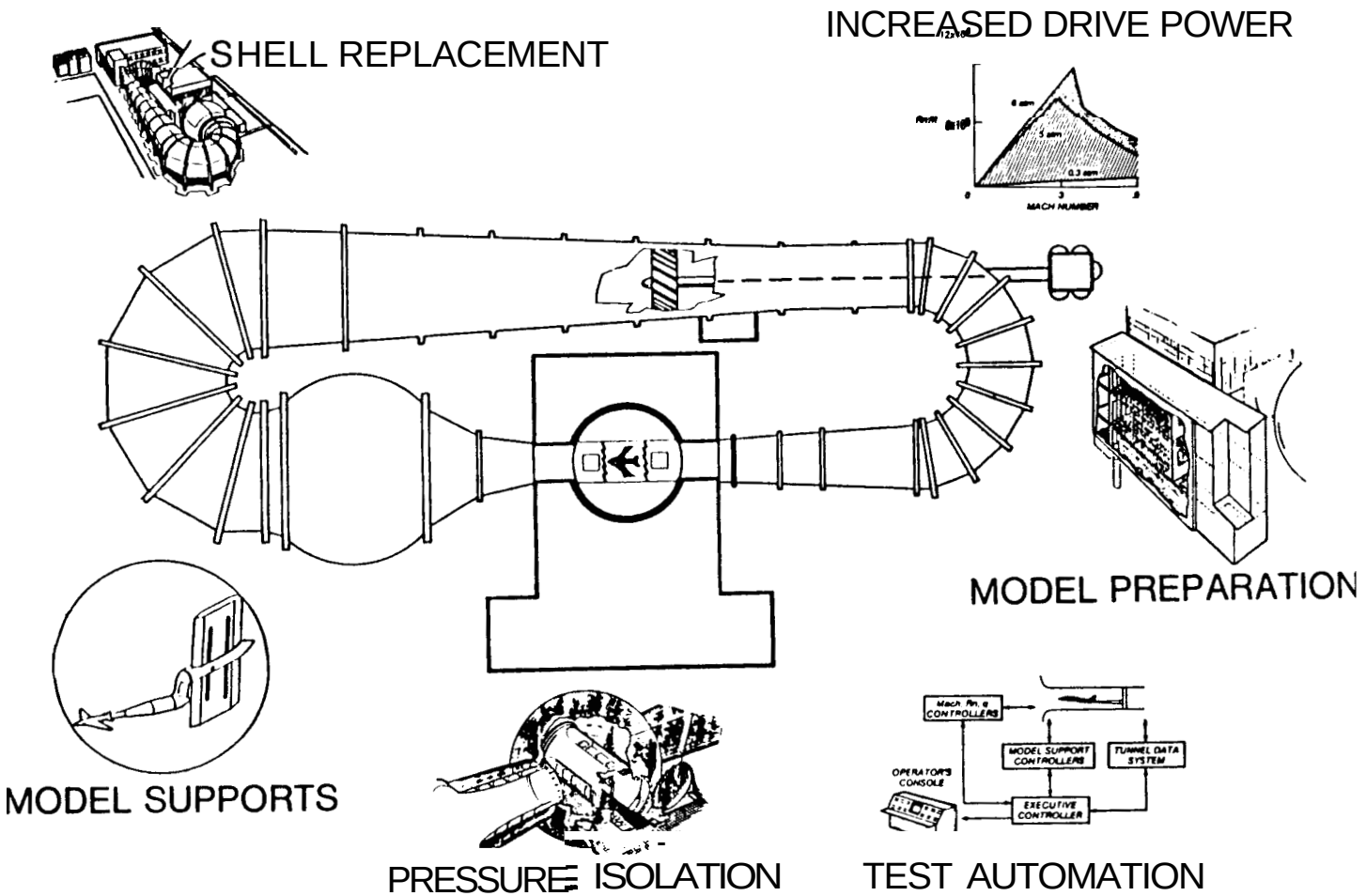


Figure 3

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Rehabilitation and Modifications to 10x10 Supersonic Wind Tunnel

INSTALLATION: Lewis Research Center

FY 1989 CoF Estimate: $14,500,000

LOCATION OF PROJECT: Cleveland, Cuyahoga County, Ohio

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology (OAST)

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding	1,340,000	---	1,340,000
Capitalized Investment	---	34,634,000	34,634,000
Total	$1,340,000	$34,634,000	$35,974,000

SUMMARY PURPOSE AND SCOPE:

This project provides for the rehabilitation and modification of the 10x10-Ft. Supersonic Wind Tunnel (SWT) in order to improve productivity and ensure future reliability and capability. This facility, built in 1955, is used for a wide variety of propulsion and nonpropulsion-related research; including testing of actual new aircraft propulsion systems, new propulsion system concepts, new inlet/engine integration concepts, advanced inlets and nozzles, and advanced aircraft configurations. This project will provide a new model buildup/calibration/checkout

area; rewind and rehabilitate the drive motors; provide new drive motor controls, and new wind tunnel controls; and rehabilitate and automate the existing air dryer. This project also will repair the tunnel expansion joints, rehabilitate the main drive compressor, and install a new roll/pitch capability to the existing model support.

This major rehabilitation and upgrade project is a key element of the NASA Aeronautical Facilities Revitalization Plan for restoring and modernizing our basic facility capabilities for aeronautical research, technology development and testing, It is one of those major projects included in FY 1989 for this purpose.

PROJECT JUSTIFICATION:

The 10x10 SWT is the only NASA unitary plan wind tunnel having propulsion capability with a speed greater than Mach 2.0. It is one of only two large propulsion facilities in the free world, but is the only tunnel that can operate in an open circuit mode without the need of a scoop system to collect combustion products. Testing in this facility is varied and includes operating aircraft engines (turbojets, turbofans); propulsion concepts such as turboprops, advanced inlets and nozzles for a range of applications; performing engine/inlet compatibility concepts, and advanced aerodynamic aircraft concepts and configurations. Rehabilitation and modifications are now required to restore and modernize major systems, and to improve productivity by adding modern real-time feedback controls for automated tunnel operation and by construction of a model calibration and checkout area to reduce tunnel downtime for model installation and checkout.

The 10x10 SWT will be used as an integral and critical component for testing in support of several multiagency programs in developing and verifying new, previously unexplored technologies. For example, the National Aerospace Plane (NASP) program will involve the development of an advanced airbreathing propulsion system with capabilities far beyond any current system. Research will be performed to ekamine boundary layer effects, bleed effects, and variable geometry concepts. New nozzle geometries will be tested, as well as full engine module performance, component interactions, propulsion mode transitions, controls, and dynamics. Another use of the 10x10 SWT will be testing of the Advanced Tactical Fighter (ATF). In addition, new aircraft configurations will be tested to examine airframe aerodynamics as it effects the inlet, engine, and nozzle performance, and to help determine the optimum propulsion system location.

A critical item of work in this project is rewinding the tunnel drive motors. Periodic measurements of these motors indicate deterioration of the insulation which preceeds major motor failure. Presently, half of the drive motor readings are outside the reliable operating range. A drive motor failure would seriously impact planned research programs. The drive motor control systems must also be replaced. These original systems designed in the early 1950's are based on vacuum tube technology. In some cases, replacement parts are no longer available. The Air Dryer is also outmoded and in need of replacement. The basic wind tunnel control system is outdated, extremely slow and needs modernizing. The new system will be a state-of-the-art distributed control system and that will

significantly improve energy efficiency and productivity. New model calibration areas are also needed to improve productivity. Currently, a considerable amount of the model buildup, as well as checkout and calibration, are done in the test section. These new areas will permit an estimated 40 percent increase in tunnel testing capability, since calibration and checkout will be performed outside of the test section.

IMPACT OF DELAY:

Most of the planned technology development programs to be performed in the 10x10 SWT for new propulsion systems and aircraft systems have high national interest. Based on current schedules, the construction period will limit the impact on defense-related test programs. Delay to a later fiscal year would adversely affect many technology development programs, and the risk of a catastrophic compressor motor failure becomes greater with consequent longer down times for repair.

PROJECT DESCRIPTION

The work in this project includes:

a. Rewinding of seven large tunnel drive motors and stators. Four 37,500 HP motors are located in the main drive system (Building No. 90) and three 33,000 HP are located in the secondary drive system (Building No. 87). The rotors will be removed, rewound, and reinsulated. The stators will be refurbished in place using modern technology and materials.

b. Replacement of the speed control system and subsystems in the main drive (Building No. 90) and secondary drive (Building No. 87) with modern electrical devices. Included will be the replacement of vacuum tube circuits, saturable core reactors, selenium rectifiers, mechanical timers, and speed-measuring circuits with modern solid-state equipment.

c. Installation of a new tunnel control system to automate and integrate tunnel operation. The systems to be automated include strut and sting, compressors 1 and 2, coolers 1 and 2, flexible wall, second throat, air heater, tunnel pressure, fuel, 3,000 psi air, and routing valve control. Obsolete equipment, pneumatic controllers, mechanical relays, and old cabling will be replaced. In addition, the control room will be rehabilitated to accept the new control equipment and systems.

d. The air dryer reactivation system will be automated to permit hands-off operation during times of non-interference with other tunnel functions. The air dryer burner systems will be updated to meet current safety codes. Thirty-year-old starters for combustion air and cooling flows will be replaced. The deteriorated

desiccant supporting structure will be rebuilt, new screens installed, and the steel support structure cleaned and painted.

e. Two model preparation and calibration areas will be provided in Building 113 to allow build-up and checkout of sting and strut- mounted models. Each will have model supports; hydraulics, signal conditioning, and a control station to validate model control and instrumentation. One area will be enclosed for security of classified models.

f. Numerous metal seals and joints around the tunnel loop will be weld repaired, and flexible seals and joints will be replaced.

g. The Main Drive Compressor will be opened for inspection. All internal parts of the compressor will be inspected, cleaned, seals replaced, and parts found to be defective will be replaced.

h. A new roll/pitch control device will be installed on the model support system to improve productivity by providing capability for making quick changes to model test orientation.

PROJECT COST ESTIMATE:

Project cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	---
Rewind Drive Motors	EA	7	875,714	6,730,000
Drive Motor Speed Controls	LS	---	---	1,340,000
Tunnel Controls	LS	---	---	2,140,000
Air Dryer Automation	LS	---	---	2,250,000
Model Preparation Areas	EA	2	620,000	1,240,000
Repair Tunnel Expansion Joints	LS	---	---	750,000
Rehabilitation of Main Drive Compressor	LS	---	---	450,000
Pitch Model Support	LS	---	---	200,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				$14,500,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Wind Tunnel Project Schematic

OTHER EQUIPMENT SUMMARY:

No other equipment is required to complete this project.

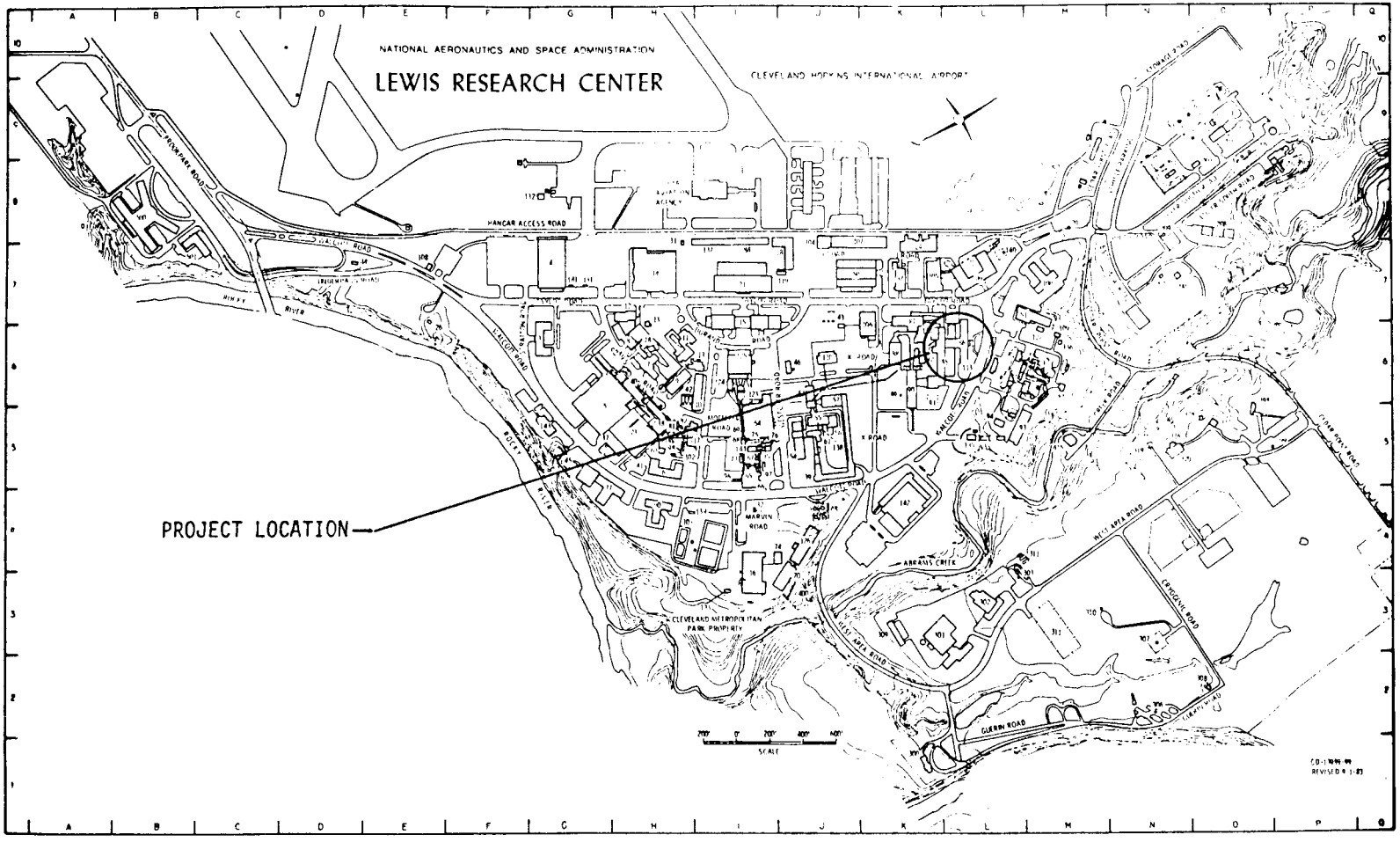
FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is required to complete this project.

LEWIS RESEARCH CENTER

FISCAL YEAR 1989 ESTIMATES

REHABILITATION AND MODIFICATION TO 10x10 SUPERSONIC WIND TUNNEL



LOCATION PLAN

FIGURE 1

LEWIS RESEARCII CENTER

FISCAL YEAR 1989 ESTIMATES

REHABILITATION AND MODIFICATION TO 10x10 SUPERSONIC WIND TUNNEL
WIND TUNNEL PROJECT SCHEMATIC

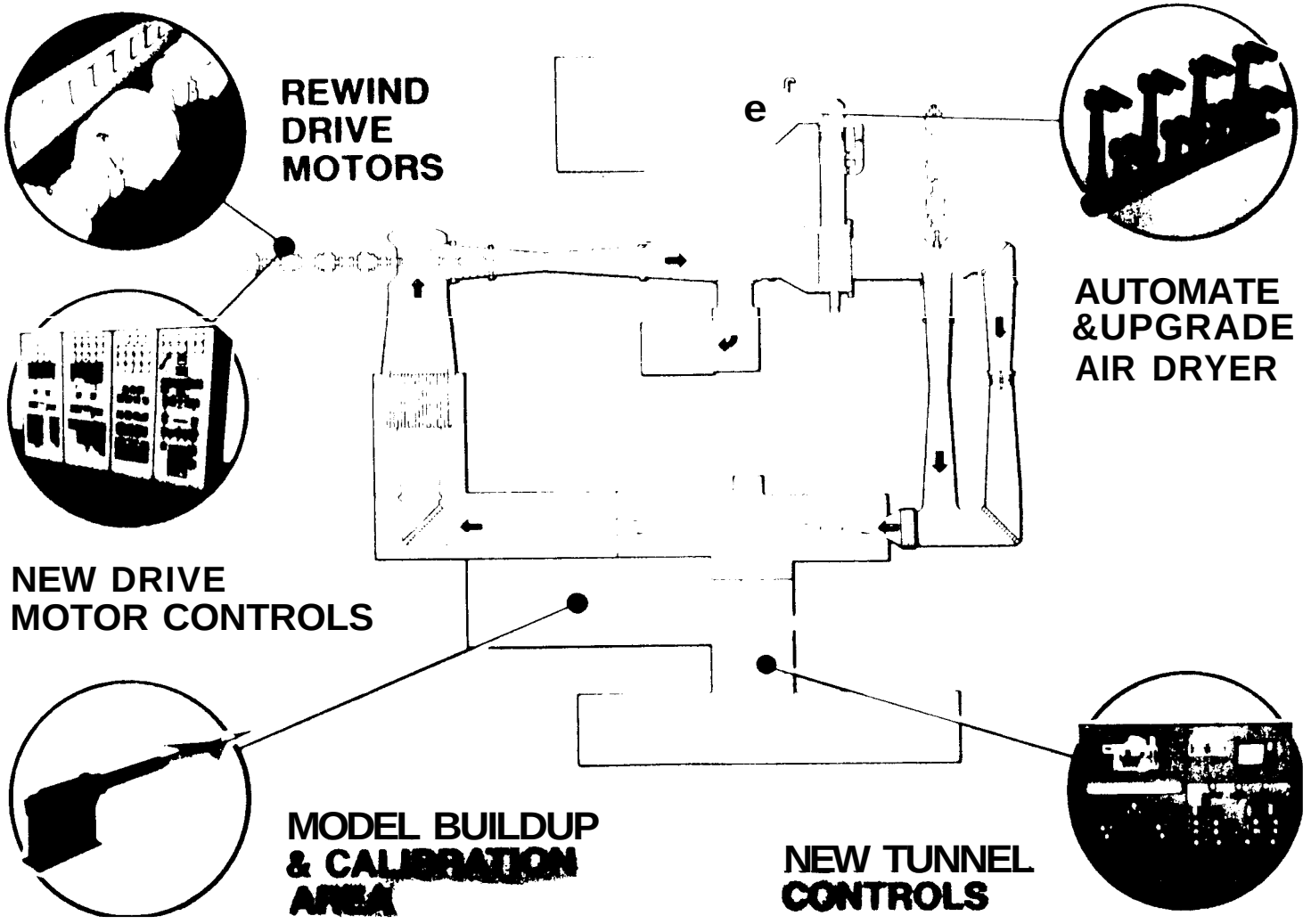


FIGURE 2

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Refurbishment of Hypersonic Facilities Complex

INSTALLATION: Langley Research Center

FY 1989 CoF Estimate: $12,800,000

LOCATION OF PROJECT: Hampton, Virginia

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	$1,190,000	$ 1,730,000	$ 2,920,000
Capitalized Investment.....	N/A	80,736,594	80,736,594
Total.....	$1,190,000	$82,466,594	$83,656,594

SUMMARY PURPOSE AND SCOPE:

This project refurbishes the Hypersonic Facilities Complex (HFC) by replacing worn out and obsolete components to improve reliability, flow quality and productivity of the many small-scale facilities in this complex. The HFC includes the Hypersonic CF_4 Tunnel (HCF_4T) in Building 1275; the 31-inch Mach 10 Tunnel (31-InM10T) in Building 1251; the 20-inch Mach 6 Tunnel (20-InM6T), Mach 8 Variable Density Tunnel (M8VDT), and Mach 6 High Reynolds Number Tunnel (M6HRNT) and vacuum pumping station in Building 1247D; and the Hypersonic Helium Tunnel (HHET), and the

Hypersonic Nitrogen Tunnel (HN_2T) in Building 1247B. The Hypersonic Propulsion Test Cells 1 and 2 in Building 1221 will be modified to provide scramjet research capability by installing a new vacuum system.

This refurbishment and upgrade project is a key element of the NASA Aeronautics Facilities Revitalization Plan for restoring and modernizing our basic facility capabilities for aeronautical research, technology development and testing.

PROJECT JUSTIFICATION:

The Hypersonic Facilities Complex (HFC) includes a number of wind tunnel facilities for performing hypersonic aerodynamic and aerothermodynamic research. This complex provides a test capability for conceptual development and evaluation, optimization analysis, and configuration studies of space vehicles.

The research facilities in the HFC were developed in the late 1950's and early 1960's for hypersonic and hypervelocity testing. Since that time, the HFC has been in continuous operation with a supporting technical staff. Now, some critical components are worn out and must be replaced. Some equipment has become obsolete and must be modified to increase productivity and improve tunnel flow characteristics.

The HFC utilizes small blowdown tunnels which employ inexpensive models to perform in a broad spectrum of operating conditions in terms of Mach Number, Reynolds Number, ratio of specific heat, and hypersonic viscous interaction parameters. Refurbishment of the HFC is needed to support continued development of the aerothermodynamic technology data base for such programs as the National Aero-Space Plane (NASP) and Aeroassisted Orbital Transfer Vehicle (AOTV).

Hypersonic Propulsion Test Cells 1 and 2 are facilities for small-scale, high-run-frequency scramjet research. They support research in combustor design, fuel injector configurations, ignition, flameholding, hypersonic inlet performance, and complete subscale engine performance. The cells provide an environment for testing with liquid hydrogen and hydrocarbon fuels. Their present primary limitation is the exhaust system. The new 70-foot vacuum sphere will provide the needed reduced back pressure capability, allowing Mach 4 to 6 testing with altitude simulation from 50,000 to 100,000 feet. In addition, the vacuum sphere will uncouple the test cells from other facilities which compete for air service.

IMPACT OF DELAY:

The wind tunnels and test cells in the HFC are in need of immediate repair, replacement of critical equipment, and modifications to improve operations. Continued delay will jeopardize the ability to provide uninterrupted hypersonic test support for development of the advanced technology data base required for the NASP, AOTV, AFE (Aeroassist Flight Experiment) and ASTS (Advanced Space Transportation Systems).

PROJECT DESCRIPTION:

This project will refurbish wind-tunnel facilities in the HFC and increase vacuum pumping capability for air and nitrogen systems supporting these facilities. Vacuum systems for the Building 1247 complex will be upgraded by the installation of a new pumping system to reduce pump downtime, provide longer run times, greater productivity, and increased reliability.

Modifications to the Hypersonic Helium Tunnel in Building 1247B include a higher capacity helium heater, a new Mach 20 nozzle, and a flow field survey probe. Modifications to the Hypersonic Nitrogen Tunnel include a pressure/ temperature control system, high pressure nitrogen system, flow field survey systems, pitot probe system, model cooling system, enhanced schlieren windows, and test section pumping station.

Modifications to the 20-inch Mach 6 tunnel in Building 1247D include a new model support and injection system, air supply system heater tube bundle, flow field survey probe system, filter system, and the control room. Modifications to the Mach 8 Variable Density Tunnel include a new nozzle, replacement air supply system, a new in-line filter, and upgraded control room. Modifications to the High Reynolds Number Mach 6 Tunnel include a new model support system for increased productivity, installation of a flow field survey system, and the control room.

Modification of the 31-inch Mach 10 Tunnel, Building 1251, will provide a new nozzle throat section and an in-line filter to reduce the flow contamination level, flow field survey system, pitot probe system, a schlieren system, and angle-of-attack drive system.

Modification of the Hypersonic CF_4 tunnel in Building 1275 will provide a new refrigeration system for CF_4 (tetrafluoromethane) recovery, flow field survey probe, filter system, injected probe system, and lead bath heater bundles.

Modifications to the Hypersonic Propulsion Test Cells 1 and 2 in Building 1221 will provide for increased facility capability and productivity by the installation of a new vacuum system. Included are a 70-foot vacuum sphere, cooling system, multi-stage steam ejector and related controls.

PROJECT COST ESTIMATE:

Project cost estimates are based on a Preliminary Engineering Report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition	---	---	---	---
Construction	---	---	---	$12,800,000
Vacuum Pumping System	LS	---	---	2,070,000
Helium Tunnel	LS	---	---	1,030,000
Nitrogen Tunnel	LS	---	---	1,880,000
20" Mach 6	LS	---	---	1,360,000
Mach 8 Variable	LS	---	---	1,150,000
High Reynolds Numbers Mach 6	LS	---	---	570,000
31-inch Mach 10 Tunnel	LS	---	---	930,000
CF_4 Tunnel	LS	---	---	610,000
Propulsion Test Cells 1 and 2	LS	---	---	3,200,000
Equipment	---	---	---	---
Fallout Shelter (not feasible)	---	---	---	---
Total				$12,800,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Hypersonic Facilities Complex Capability
Figure 3 - Site Plan and Schematic of Propulsion Facility

OTHER EQUIPMENT SUMMARY:

No ii equipment is d

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

There are no requirements identified for future CoF funding.

LANGLEY RESEARCH CENTER
FISCAL YEAR 1989 ESTIMATE

REFURBISHMENT **OF** HYPERSONIC FACILITIES COMPLEX

LOCATION PLAN

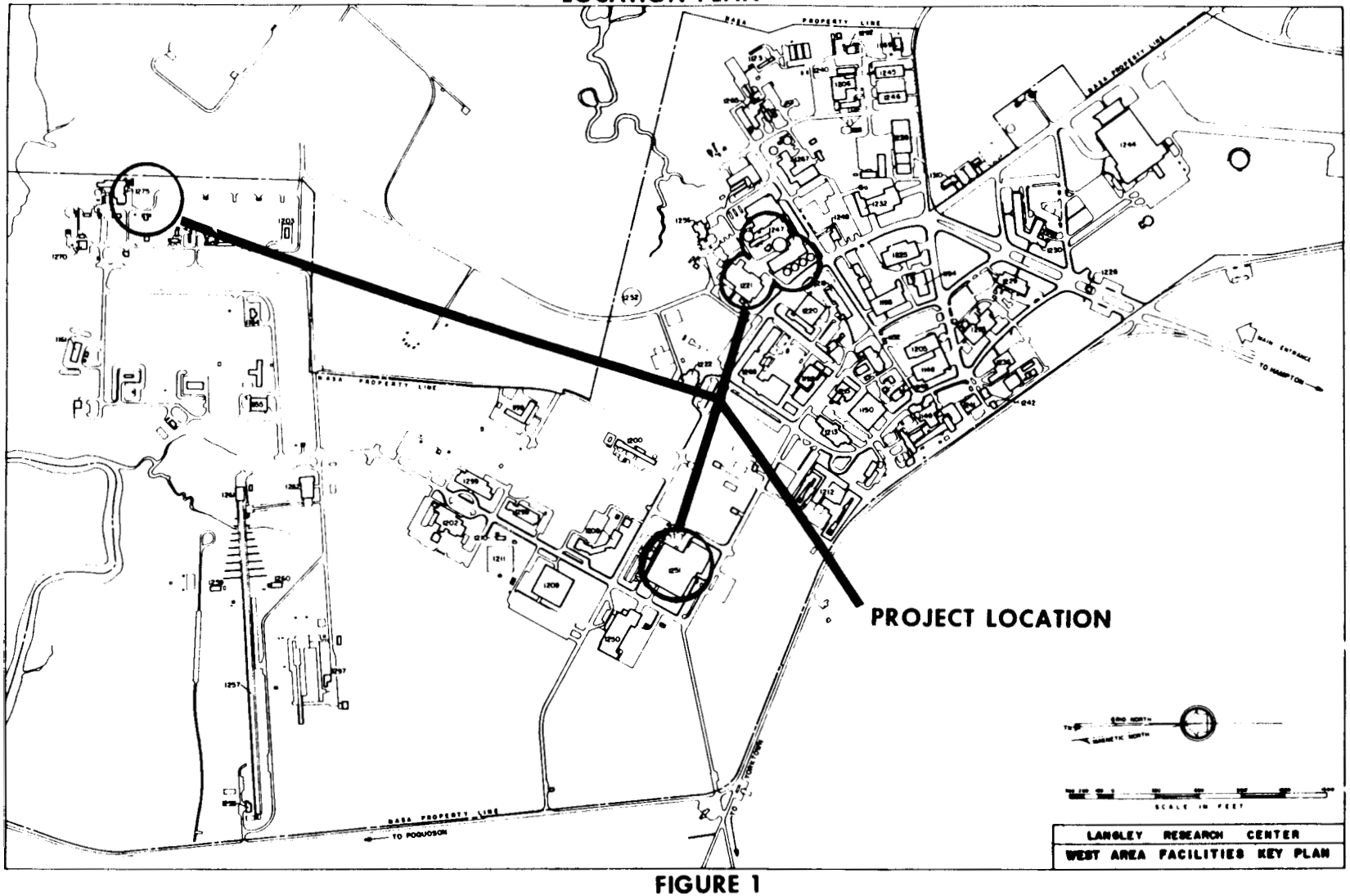
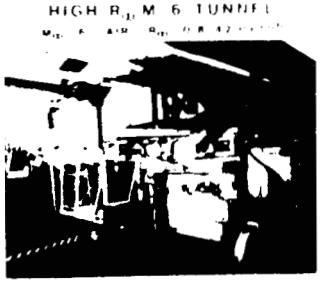
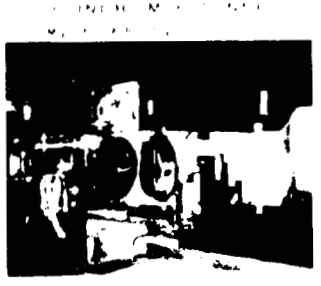


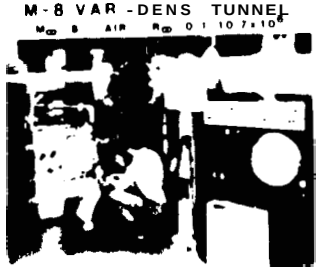
FIGURE 1

LANGLEY RESEARCH CENTER
FISCAL YEAR 1989 ESTIMATE

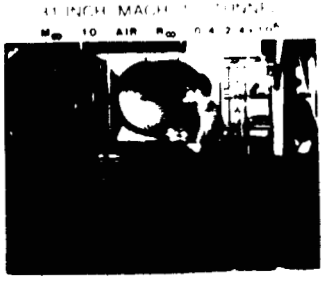
REFURBISHMENT OF HYPERSONIC FACILITIES COMPLEX
HFC OPERATING CONDITIONS

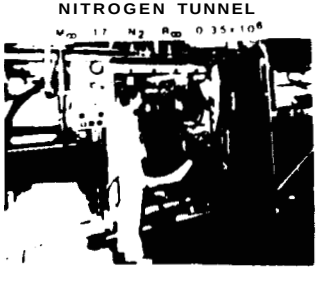






HYPERSONIC FACILITIES COMPLEX





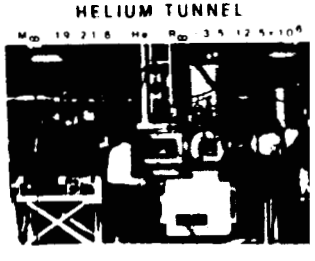


FIGURE 6

LANGLEY RESEARCH CENTER
FISCAL YEAR 1989 ESTIMATES

REFURBISHMENT OF HYPERSONIC FACILITIES COMPLEX
SITE PLAN AND SCHEMATIC OF PROPULSION FACILITY

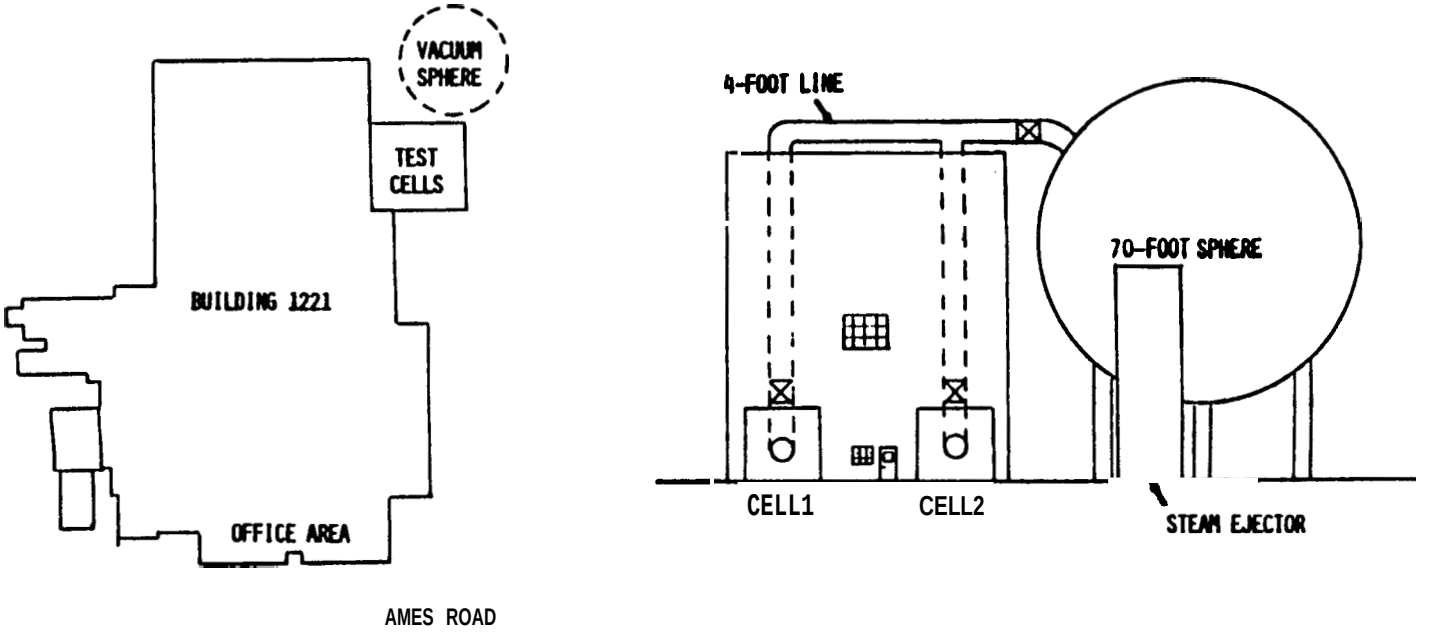


FIGURE 3

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

LEWIS RESEARCH CENTER

	Amount	Page No.
Office of Aeronautics and Space Technology:		
Refurbishment of Electric Power Laboratory.....	6,100,000	CF 8-1

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Refurbishment of Electric Power Laboratory

INSTALLATION: Lewis Research Center

FY 1989 CoF Estimate: $6,100,000

LOCATION OF PROJECT: Cleveland, Cuyahoga County, Ohio

COGNIZANT HEADQUARTERS OFFICE: Office of Aeronautics and Space Technology (OAST)

FY 1988 AND PRIOR YEARS' FUNDING: The following prior years' funding is related to this project:

	Planning and Design	Construction	Total
Specific CoF Funding.....	$488,000	---	$ 488,000
Capitalized Investment.....	---	$6,566,000	6,566,000
Total.....	$488,000	$6,566,000	$7,054,000

SUMMARY PURPOSE AND SCOPE:

This project will refurbish one vacuum chamber (Tank 5) in the Electric Power Laboratory (EPL), Building 301, to improve productivity and reactivate a second, existing large vacuum chamber (Tank 6) to provide additional capability for research, technology development on power sources, conversion systems, thermal management and electric propulsion; and to test large space systems under simulated thermal/vacuum conditions. Support system and utility modifications will improve reliability, and the system pumping speed will be enhanced to help improve productivity.

PROJECT JUSTIFICATION:

Availability of two fully functional, large vacuum chambers in the EPL is mandatory to successfully support ongoing space research and technology and development programs sponsored by NASA/OAST, DOD, and others. Major efforts in Advanced SP-100 space nuclear reactor, Advanced Solar Dynamics, Thermal Management and Space Station power require large volume chambers with thermal high vacuum environments. Other programs, including environmental interactions, space tether, and electric propulsion basic research and technology and development for Space Station, require extremely high pumping speeds.

Tank 5 is currently operational and is completely subscribed to support present R&D programs, which do not include testing that will be required for Advanced SP-100, Solar Dynamics, Thermal Management, or Space Station power programs. Tank 6 was used in the past for ion propulsion system tests and is contaminated with mercury residue from those tests, in addition to having numerous internal system leaks. Reduced testing requirements have allowed this tank to be kept out service for many years. The increased workloads now require that Tank 6 be refurbished and returned to service. Additionally, neither facility has LN_2 cold walls, and, therefore, no large chamber thermal vacuum test capability. **Also**, numerous failures have occurred in the 30-year-old pumping trains and the existing instrumentation and controls. These systems must be rehabilitated to improve system reliability and increase productivity through real-time data collection and controls.

IMPACT OF DELAY:

Failure to provide two completely operational and increased productivity thermal vacuum chamber tanks will result in displacement/curtailment of several Office of Aeronautics and Space Technology (OAST) Research and Technology (R&T) efforts and other non-OAST programs.

PROJECT DESCRIPTION:

This project will modify and refurbish the two existing large space environment chambers, install new model preparation and assembly areas, and modify the facility support systems. Tank 6 will be restored to a fully operational condition by removal of mercury contamination, replacing diffusion pump cold traps, mechanical vacuum pumps, piping and valves. In addition, new LN_2 cryopanels will be installed in both Tanks 5 and 6. Tank 5 vacuum system compressors will be replaced, and a new helium compressor installed. Facility controls will be upgraded, the existing LN_2 and freon systems will be modified, and a GH_2 supply system will be installed to support both vacuum tanks.

PROJECT COST ESTIMATE:

This project cost estimate is based on a preliminary engineering report.

	Unit of Measure	Quantity	Unit cost	cost
Land Acquisition.....	---	---	---	---
Construction.....	---	---	---	$6,100,000
Site Development/Utilities...	---	---	---	-0-
Building	LS	---	---	6,100,000
Chamber 6				
Decontaminate Vacuum Tank.....	LS	---	---	(1,860,000)
Replace Vacuum Pumps and Piping....	LS	---	---	(973,000)
Install LN_2 Baffle System.....	LS	---	---	(957,000)
Install Clean Room Assembly Area.....	LS	---	---	(188,000)
Modify Control System	LS	---	---	(379,000)
Vacuum Tank Modifications.....	LS	---	---	(233,000)
Chamber 5				
Replace Vacuum Pump and Piping.....	LS	---	---	(341,000)
Install LN_2 Condenser.....	LS	---	---	(551,000)
Install Helium Compressor	LS	---	---	(27,000)
Vacuum Tank Modifications.....	LS	---	---	(131,000)
Cryogenic Systems				
Extend LN_2 Distribution System.....	LS	---	---	(217,000)
Install GH_2 Generator System....	LS	---	---	(151,000)
Modify Freon System Controls.....	LS	---	---	(92,000)
Equipment.....	---	---	---	---
Fallout Shelter (not feasible).....	---	---	---	---
Total.....				$6,100,000

LIST OF RELATED GRAPHICS:

Figure 1 - Location Plan
Figure 2 - Project Schematic Plan
Figure 3 - Vacuum Chamber (Tank 6) Cut-Away Schematic

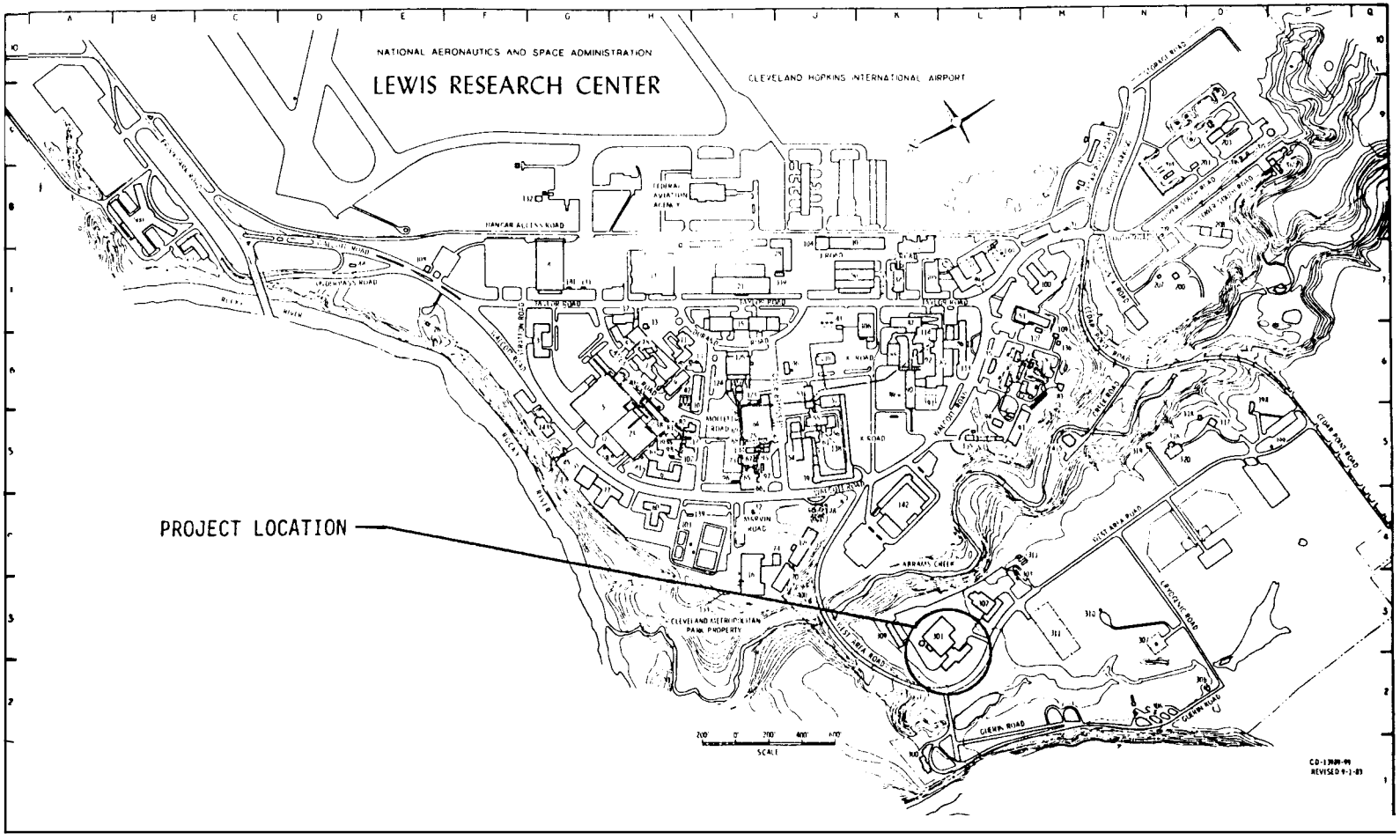
OTHER EQUIPMENT SUMMARY:

No other equipment is required to complete this project.

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

No future CoF funding is required to complete this project.

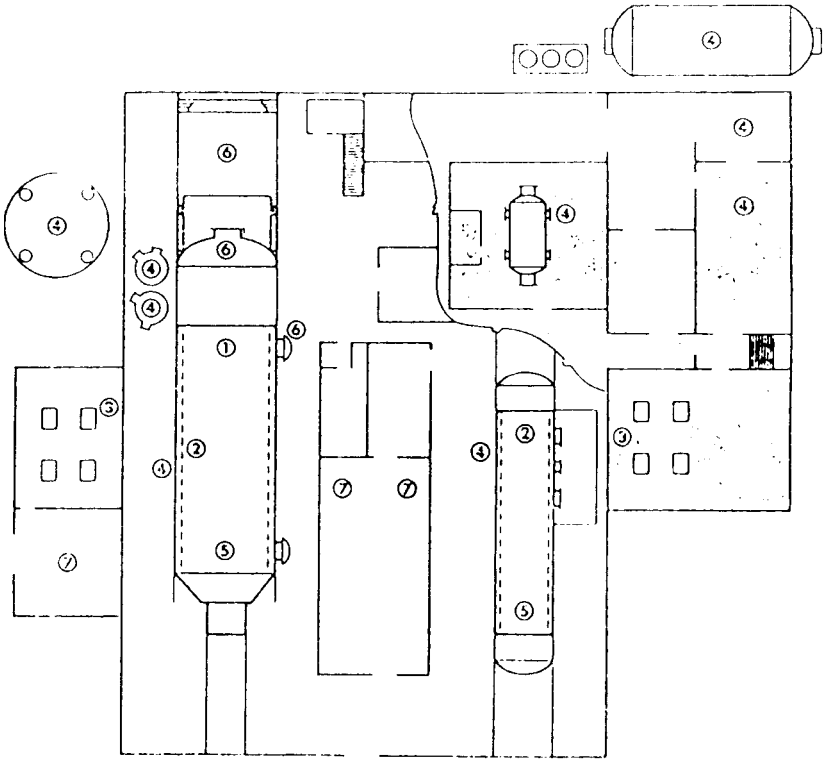
LEWIS RESEARCH CENTER
FISCAL YEAR 1989 ESTIMATES
REFURBISHMENT OF ELECTRIC POWER LABORATORY



LOCATION PLAN

FIGURE 1

LEWIS RESEARCH CENTER
FISCAL YEAR 1989 ESTIMATES
REFURBISHMENT OF ELECTRIC POWER LABORATORY
PROJECT SCHEMATIC PLAN

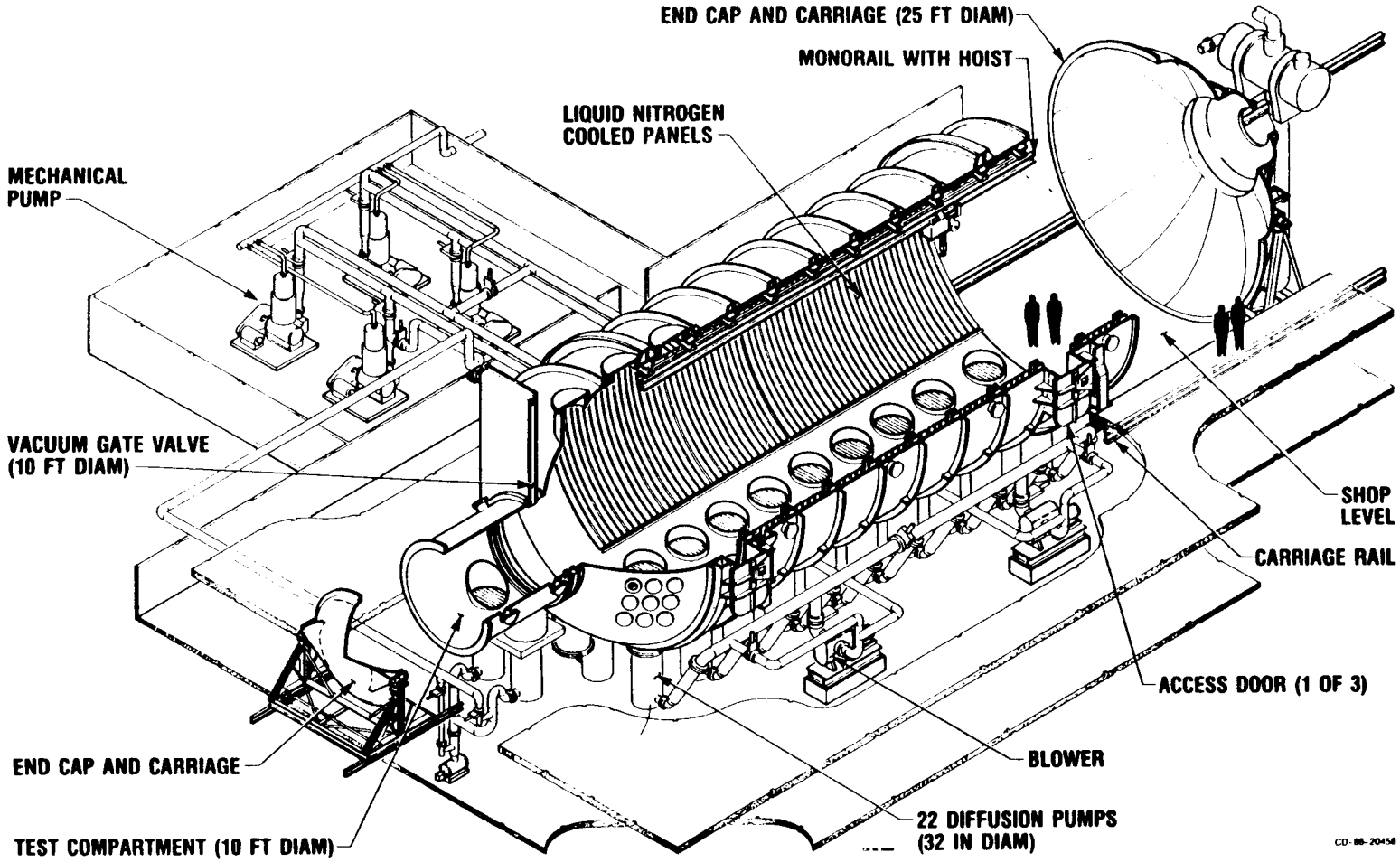


EPL COMPLEX

1. CLEAN TANK 6 (REMOVE CONTAMINATION)
2. INSTALL NEW LN_2 BAFFLES (T-5, T-6)
3. REPLACE MECHANICAL VACUUM PUMPS (T-5, T-6)
4. INSTALL LN_2 DISTRIBUTION SYSTEM
5. PROVIDE IMPROVED VACUUM ENVIRONMENT (T-5, Tb)
   - NEW TRAPS
   - INERT GAS SYSTEM
6. ENHANCE AND PROVIDE EXPANDED CAPABILITIES FOR LARGE EXPERIMENT TESTING (T-6)
   - 25 FT DIAMETER ACCESS
   - LARGE ASSEMBLY AREA
   - NEW MANNED ACCESS
   - 3 TON HOIST AND MONORAIL SYSTEM
   - NEW VENTILATION SYSTEM
7. REHABILITATE AND UPDATE FACILITY CONTROLS AND ISSTRUMENTATON (T-5, T-6)

FIGURE 2

LEWIS RESEARCH CENTER
FISCAL YEAR 1989 ESTIMATES
REFURBISHMENT OF ELECTRIC POWER LABORATORY



VACUUM CHAMBER (TANK 6)
CUT-AWAY SCHEMATIC

Figure 3

VARIOUS LOCATIONS

REPAIR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

REPAIR

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	$1.945.000	CF 9-3
Dryden Flight Research Center	995,000	CF 9-4
Goddard Space Flight Center	2.010.000	CF 9-4
Jet Propulsion Laboratory	1.520.000	CF 9-5
Johnson Space Center	2.590,000	CF 9-6
Kennedy Space Center	3.450.000	CF 9-8
Langley Research Center	3,270,000	CF 9-10
Lewis Research Center	3.400.000	CF 9-12
Marshall Space Flight Center	1.680.000	CF 9-13
Michoud Assembly Facility	1,330,000	CF 9-14
National Space Technology Laboratories	1.415.000	CF 9-15
Wallops Flight Facility	1,930,000	CF 9-15
Various Locations	200.000	CF 9-16
Miscellaneous Projects Not Exceeding $150.000 Each	1.265.000	CF 9-17
Total	$27.000.000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Repair of Facilities, Not in Excess Of $750,000 Per Project

INSTALLATION: Various Locations

FY 1989 CoF ESTIMATE: $27,000,000

FY 1987: $24,400,000 FY 1988: $25,000,000

COGNIZANT INSTALLATIONS/LOCATIONS OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for large repairs to facilities at NASA field installations and Government-owned industrial plants supporting NASA activities. Included in the request are those facility repair needs for FY 1989 that can be foreseen at the time of the submission of these estimates, and are not to exceed $750,000 per project. The thrust of this program is to restore facilities or components thereof, including collateral equipment, to a condition substantially equivalent to their originally intended and designed capability. The request includes the substantially equivalent replacement of utility systems and collateral equipment necessitated by incipient or actual breakdown. This work also includes major preventive measures which are normally accomplished on a cyclic schedule of greater than 1 year.

PROJECT JUSTIFICATION:

A major portion of the agency's facilities exceeds 25 years in age, and increases in repair requirements are to be expected. Maintenance and repair costs for mechanical and electrical systems in a typical building are almost three times higher during the 16- to 30-year period of a building's life than they are during the

initial 15 years. Many electrical and mechanical components reach the end of their serviceable or economic life at about the 15 to 20 year point, and should be replaced in the interest of long-term economy. Continued piecemeal repair of these components is usually more costly in the long run than replacement at the end of the economic life of the original components. Approximately 75 percent of NASA's physical plant is in the 16- to 30-year old category.

A major thrust of this repair program, along with the rehabilitation and modification programs, is to preserve the capabilities of the agency's $4.0 billion physical plant. An analysis of each project clearly indicates that this work must be addressed and progressively accomplished. Otherwise, risks are increased and future costs of the specific work will be greater. More importantly, there will be increased breakdowns interruption of critical operations, and costly unscheduled repairs required.

This program includes only facility repair work having an estimated cost not in excess of $750,000 per project. The work is of such a nature and magnitude that it cannot be accomplished by routine day-to-day facility maintenance and repair activities. Repair projects estimated to cost more than $750,000, are included as separate discrete projects in the budget request.

PROJECT DESCRIPTION:

Proposed repair projects for FY 1989 totaling $27,000,000 are described under "PROJECT COST ESTIMATE." Projects estimated to cost not in excess of $150,000 have not been individually described or identified by Center, and the total request for these projects is $1,265,000. This repair program has been distilled from requests of approxiamately $46,000,000, and thus represents a modest request in relation to the continuing backlog of this type of work. Based on relative urgency and expected return on investment, the projects which comprise this request are of the highest priority. Deferral of this mission-essential work would adversely affect the availability of critical facilities and program schedules.

During the course of the year, it is recognized that some rearrangement of priority may be necessary. This may force a change in some of the items to be accomplished. Any such change, however, will be accomplished within total available repair resources. The following broad categories of work are described further in the "PROJECT COST ESTIMATE":

a.	Utility Systems..	8,900,000
b.	General Purpose Buildings.	3,500,000
c.	Technical Buildings/Structures.	6,600,000
d.	Pavements and Drainage	4,700,000
e.	Building Exteriors and Roofs	3,300,000

PROJECT COST ESTIMATE:

A.	Ames Research Center (ARC)....	$1,945,000
1.	Repair of 11x11-ft Transonic Wind Tunnel	750,000

This project provides for the complete installation of after-cooler coils for the Transonic Wind Tunnel. The coils being replaced are over 25 years old and corrosion leaks are such that repair is no longer possible. Without replacement increased downtime to make emergency spot repairs is probable, as well as possible damage to the compressor due to lube oil contamination by the cooling water.

2.	Replacement of the HVAC Systems (N-233 and N-239)...	595,000

This project provides for the replacement of two centrifugal chillers with associated controls, pumps, valves, and piping in Building N-233, and for removal and reinstallation of interior duct insulators in N-239. The existing equipment and ductwork is over 20 years old and has become very unreliable. Since both systems serve numerous computer facilities, it is essential that dependable equipment be available to support these critical areas.

3.	Repair of Pressure Vessels, Various Locations	400,000

This project provides for the repair of the systems serving the following facilities to permit recertification. (1) isolation valves for the high-pressure storage tanks for the 3.5-ft Wind Tunnel; and (2) the 8-inch isolation valve for the 3.5-ft Wind Tunnel. Repairs include new welds, pipe replacement, valve and flange replacement, the addition of support structures and restraints, and ultrasonic and radiographic inspection as needed for recertification.

4. Repair of Sanitary Sewer and Water Distribution Systems..... 200,000

This project provides for the following: (1) replacement of 800 linear feet of 12-inch sanitary sewer main including rerouting near Buildings N-210 and N-243; (2) installation of five new manholes; and (3) installation of three 18-inch gate valves on the existing water mains. Additions to the sewer have exceeded capacity levels resulting in overflow discharge onto streets through the manholes. The new manual gate valves are required to minimize the amount of downtime of the water system. Currently, the entire system must be shut down to work on a particular section. The new valves will permit sectionalizing the systems for shutdown.

B. Dryden Flight Research Facility (DFRF)..... $995,000

1. Repair of Building 4800 for Seismic Safety..... 745,000

This project will improve the seismic survivability of Building 4800 by providing lateral resistance. Existing unreinforced concrete masonry walls will be strengthened by installing 16-gauge "Zee" sections at 4 feet on center from floor to ceiling; and covering these sections with gypsum board. The existing building does not meet the Uniform Building Code and would probably not survive a severe earthquake. This repair is necessary to improve the seismic response of the building and to improve survivability of the inhabitants during an earthquake.

2. Repair to Roads and Paving..... 250,000

This project provides for the application of a 2-inch asphalt overlay of 125,000 square feet of Baker-Nunn Road, 75,000 square feet of Lilly Ave., 80,000 square feet of Forbes Ave., and 70,000 square feet of Lakeshore Drive. Surface stress and cracking is accelerating and if not treated now will require complete replacement of the road surfaces.

C. Goddard Space Flight Center (GSFC)..... $2,010,000

1. Repair Switchgear Components.... 580,000

This project provides for the replacement of portions of the switchgear equipment in the Central Flight Control and Range Operations building and the Spacecraft Operations Facility. Repair work including the replacement of primary switches, secondary main and automatic tie breakers, branch feeder circuit breakers, metering, instrumentation, and other ancillary items are required. The subject switchgear systems

were installed in the early 1960's when the buildings were constructed. Currently, these system components are obsolete and spare parts are no longer manufactured. Proposed work would improve electrical system reliability and reduce maintenance costs for this mission-critical building complex.

2. Repair Air-conditioning Systems and Temperature Controls..... 700,000

This project provides for the repair of air-conditioning systems, including air-handling units, packaged chilled water and direct expansion units in Buildings 3 and 14. Work includes the repair of deteriorated insulation, replacement of the associated corroded plenum, mechanical components, ductwork, piping, and defective dampers within the immediate vicinity of the air-handling equipment. Also included is updating automatic temperature control systems, and replacement of instrumentation panels as necessary. Asbestos insulation on existing piping/equipment which require repair work will be removed to the extent that is necessary to perform the repairs. The existing air-conditioning systems have been in operation since the early 1960's. Due to deterioration, corrosion, and extensive operations, the entire unit must be replaced. The proposed work will improve operations efficiency, reduce maintenance cost, and enhance system reliability.

3. Repair Roofs, Various Buildings..... 730,000

The project provides for the replacement of approximately 90,000 square feet of roofing on the Instrument Construction and Installation Laboratory, Building 5; the Space Science Laboratory, Building 6; and the Visitor Center, Building 88. The work includes replacement of existing roof coping, flashing, and gravel stop. The existing roofs are more than 20 years old and contain numerous patches and temporary repairs. Proposed work will restore facility integrity and minimize potential Government property loss due to water damage.

D. Jet Propulsion Laboratory (JPL)..... $1,520,000

1. Repair of Air-Handling Units, Space Flight Operations Facility (230)..... **560,000**

This project provides for the repair of deteriorating center coil sections of air-handling unit numbers 10, 11, and 12 in Space Flight Operations Facility, Building 230. In addition to the new coil sections, new filter sections also will be built up and installed from the inside of each unit. Existing piping will be reworked as required to complete the installation of the new cooling coils and their terminal connections. The referenced air-handling units which serve the underfloor computer air-cooling systems, are near the end of their operational life. Replacement of the coil sections of the subject air-handling units is critical to improve the reliability of continuous operation of the system and provide adequate air flow for computer cooling.

2. Repair of Uninterruptible Power System (202) 260,000

This project provides for the replacement of the existing 150 KVA Uninterrupted Power System (UPS) with a new 150 KVA UPS system and associated battery network in the Procurement and Communications Support, Building 202. The existing UPS, which now supports the Program Support Communications Network (PSCN) and Network Communications Facility (NCF), was installed in 1974 in support of a Deep Space Network (DSN) computer facility. In 1981, the system was deactivated and remained dormant until 1986. Since that time numerous repairs and difficulty of obtaining spare parts have necessitated the replacement of the UPS.

3. Repair of Paving, Various Location..... 700,000

This project provides for the rebuilding of asphaltic concrete paving on DSN Road, as well as repairing and rebuilding portions of the East Parking Lot and access road. Rebuilt paving will consist of 3 inches of new paving over a 6-inch base. Repairing will consist of filling cracks and overlaying existing pavement with 1 1/2" asphaltic concrete. The portions of paving to be rebuilt are 800 linear feet of DSN Road and 2,200 linear feet of the East Parking Lot access road. The area to be repaired is approximately 300,000 square feet of parking area in the East Parking Lot. After paving, the parking lot will be restriped and the roads relined for traffic control. The existing asphaltic concrete paving of portions of DSN Road and the East Parking Lot and access road has deteriorated to a point where it is no longer maintainable. Large cracks and alligatoring of the pavement allow water to penetrate to the subgrade which eventually leads to deterioration of the adjacent paving. Repeated patching of the pavement in these areas has created a drainage problem and unsafe driving conditions which can only be corrected by rebuilding and repairing the pavement.

E. Johnson Space Center (JSC) $2,590,000

1. Repair Mission Control Center Critical Power Generators (48) 500,000

This project provides for repair/replacement of various components of the critical power generation systems located in the Emergency Power Building, No. 48. Major work includes replacing the two "A" power motor generator sets, the three "A" power diesel-driven generators, and the three "B" power diesel-driven generators. The existing generators are difficult to maintain and spare parts are no longer available. Replacement is essential to maintain the reliability and efficiency for the continued use and operation of the critical utility systems which support the Shuttle Mission Control Center.

2. Repair Cooling Tower (32) 350,000

This project will provide for the replacement of the Building 32 cooling tower with two modular cooling towers comprised of a fiberglass-reinforced polyester resin structure, filled with ceramic tile, and containing stainless steel hardware. Work includes removal of the existing cooling tower, modification of the existing concrete basin, electrical and mechanical modifications, and installation of the new cooling towers. Replacement of the cooling tower is required because of deterioration. The piping is badly corroded, the fill and drift eliminators are broken and deteriorated, and the tower hardware and structure are in very poor condition. The cooling tower replacement is essential for the continued operation of the space environment simulation chambers A and B of Building 32.

3. Repair Electrical Substations, Various Buildings..... 590,000

This project provides for repairs of the high-voltage electrical switchgear, secondary breakers, and interconnecting primary conductors at various buildings. This project will provide for removal of existing deteriorated air-type high-voltage switches and the installation of dual-circuit, primary selective loop-type switches, at Buildings 4, 8, 13, and 45. The existing secondary tie breaker at Building 1 will be supplemented with load transfer switchgear and isolation capabilities. The existing substations have deteriorated due to age and must be repaired to provide reliable electrical service to critical JSC buildings.

4. Repair Fire Protection System, Thermochemical Test Area..... 200,000

This project provides for the repair of 27 existing fire protection deluge systems in the Thermochemical Test Area. Work involves replacing or refurbishing the deluge valves and actuating devices in each system and installing test piping with diverter valves so that each system can be tested prior to the onset of a hazardous test. The work is required to provide continued reliable operation of the deluge fire protection systems which provide protection for the test cells in three thermochemical buildings. The existing systems have degraded due to age, weather, and obsolescence, resulting in unreliable operation and increased maintenance.

5. Repair Water and Natural Gas Systems, Ellington Field..... 650,000

This project repairs the underground utility systems for water and natural gas distribution in the NASA areas of Ellington Field. The water system repairs include the replacement of approximately 500 linear feet of 2-inch ductile iron pipe and 2,700 linear feet of 6-inch ductile iron pipe. Water system work also includes the installation of two chlorination points, an aeration system, activated carbon filters, and cathodic protection for the two 150,000-gallon fire suppression water storage tanks. The natural gas system

repairs include the replacement of approximately 450 linear feet of 1-inch gas line, replacement of approximately 1,615 linear feet of 2-inch gas line, and installation of a gas meter. Existing utilities are in poor condition, require a great amount of maintenance to repair leaks, have illogical and potentially dangerous line routing, and do not meet state regulations for potable water.

6. Repair of Sanitary Sewer System..... 300,000

This project provided for the repair of JSC's sanitary sewer system. Substantial pipe settlement in the sanitary sewer gravity lines has been experienced at JSC. An investigation and survey using television inspection techniques indicated that approximately 26 percent of all lines required sliplining or repair to prevent recurrent blockages. The swelling and shrinkage characteristics of the soil foundation and land subsidence has contributed to pipe's deterioration. The work in this project includes repairs to and/or sliplining of approximately 6,400 linear feet of underground gravity lines that comprise the Center sanitary sewer system. This includes approximately 5,850 linear feet of 4-inch to 8-inch lines and 550 linear feet of 10-inch and 12-inch lines. Pipe segments which are broken will be replaced on a stabilized base material for improved support.

F. Kennedy Space Center (KSC)..... $3,450,000

1. Repair Power Feeders, Shuttle Landing Facility..... 380,000

This project will replace the existing T3 and T4 Feeders from Substation 843 through distribution switches S3, S4 and S6 with new direct burial 15KV cable. The existing feeders are unreliable and require replacement in order to maintain the system in an operational condition. Replacement of the power feeder will result in reduced maintenance cost and will enhance the reliability of this critical system.

2. Repair Central Instrumentation Facility Roof..... 220,000

This project provides for the replacement of 14,000 square feet of inner roof system of the Central Instrumentation Facility. The project includes demolition of existing roofing and equipment curbs, filling vent openings with metal decking, installation of lightweight concrete and new roof drains, and installation of a new single ply roof. Failure to provide roof repairs could result in damage to ceilings, walls, and equipment in this critical facility. This facility is the central computer facility at KSC.

3. Repair LC-39 Pad A North Slope.. 180,000

This project will repair the concrete surface on the north slope of Pad A, LC-39. Soil has eroded out from under the concrete slabs and must be stabilized to prevent further damage. All cracks at the top of the pad surface will be cleaned and properly filled with a caulking material. Voids under concrete will be filled by drilling and grouting. Damaged concrete slab sections along the sloped sections will be removed and new concrete slabs will be cast in place.

4. Replace Air Handlers and Roof at SAEF-2..... 350,000

This project provides for the replacement of four air handlers with three new units, including piping. The project also provides for replacement of approximately 4,726 square feet of conventional built-up roofing and 2,195 square feet of ceiling. The existing air handlers are old and their deterioration has been accelerated due to the harsh environmental conditions. Cargo processing operations are supported in the facility and failure to provide roof repairs could result in costly damage to payloads.

5. Repair Kennedy Parkway - Wilson Corner to Haulover Canal..... 740,000

This project provides for repairs to approximately 7.5 miles of Kennedy Parkway from Wilson Corner to the Haulover Canal. This road, originally A1A, is more than 25 years old and is in very poor condition. This repair consists of approximately 3,150 tons of asphalt for leveling course, approximately 104,550 square yards of surface treatment, and approximately 116,800 feet of striping. A small segment of the road base is so badly deteriorated that it must be reconstructed. The scope of this project exceeds the performance capability of routine maintenance, and since Kennedy Parkway is the primary northern access to KSC, it must be repaired.

6. Repair Boiler Controls, Central Heat Plant..... 740,000

This project will replace the controls of the three boilers in the Central Heat Plant, including the distribution system instrumentation and interconnecting wiring and tubing with a solid state electronic control and burner management system. The existing 1963 controls use vacuum tubes which result in decreasing reliability and accuracy. Until the control system is replaced, the current operation will continue with a high failure rate that adversely impacts the environment in the Operations and Checkout Building and Central Instrumentation Facility. This will result in potential retest and recertification of cargo hardware, lost data, and equipment damage.

7. Repair Air-conditioning System in Occupational Health Facility 380,000

This project will replace the two existing refrigeration systems in the Occupational Health Facility with a new 90-ton system, including dual compressors, piping, condensers, and controls. The existing refrigeration systems are over 20 years old and have deteriorated to a point where frequent maintenance is required. Parts are difficult to obtain and the existing systems provide an unreliable source of temperature and humidity control for a facility that houses sophisticated machinery and life support equipment.

8. Repair VAB Corrugated Siding. 460,000

This project provides for repair of the exterior metal surface of the 525-foot high Vertical Assembly Building (VAB). Approximately 283,000 square feet of this siding will be cleaned and repainted with protective coating on the gray corrugated siding areas. This facility has been in continuous use since 1966 and the existing coating has deteriorated. If no corrective action is taken on this project, continued weathering deterioration to the existing coating would cause bare metal exposure of the corrugated siding to the environment. The scope of this work and the difficulty of access (height of VAB) exceeds the routine maintenance service levels available.

G. Langley Research Center (LaRC) $3,270,000

1. Repairs to Tunnel Shell, Unitary Wind Tunnel (1251) 500,000

This project provides for the repair of approximately 220 linear feet of defective welds in the tunnel shell at the Unitary Wind Tunnel (UWT), Building 1251. Work includes the removal of asbestos insulation and unacceptable weld metal, rewelding the tunnel shell, post-weld heat treatment, and radiographic inspection of the new welds. Numerous unacceptable welds have been identified during inspections of the highly stressed portions of the UWT. Repair of the unacceptable welds must be accomplished to ensure the safe and efficient operation of this research facility.

2. Repairs to Structures and Materials Research Laboratory (1148) 540,000

This project provides for the repair of the electrical power and exterior wall of the Structures and Materials Research Laboratory, Building 1148. The electrical power repairs will include the removal and replacing of a transformer, switchgear, panelboards and related work. The south exterior wall repairs will include the removal of the corrugated metal sheets and replacing with aluminum siding. This laboratory is over 45 years old and the electrical systems are obsolete and in poor condition. The south exterior wall siding is severely deteriorated and poorly insulated and must to be replaced.

3. Replace Roofs, Various Facilities..... 710,000

This project provides for the replacement of 65,000 square feet of roofing on the Fatigue and Fracture Research Laboratory, Building 1205; Cafeteria, Building 1231; and Instrument Research Laboratory east wing, Building 1230. The existing roofs will be removed and replaced with a new roofing system. The roofs have deteriorated and replacement is necessary to ensure the integrity of the facilities and to prevent damage to the equipment housed in the building.

4. Replace Transformer, Stratton Road Substation (1233)..... 690,000

This project provides for the repair of the Stratton Road Substation, Building 1233, by replacing transformer "IE." Work includes the removal of the existing transformer and replacing with a 110 KV transformer, and related electrical power equipment. The "IE" Transformer is one of four critical transformers that provide 22KV regulated power to the research facilities, is over 35 years old, obsolete, and has become unreliable. The replacement of the "IE" Transformer is necessary to ensure long-term dependable electrical power service.

5. Repair Potable Water Piping, West Area..... 280,000

This project provides for the replacement of approximately 6,500 linear feet of existing 1 1/2 to 6-inch cast iron water pipe serving ten facilities in the west area. Water mains and laterals will be replaced with polyvinyl chloride (PVC) water pipe. The existing pipe, which is over 30 years old, has deteriorated to the degree that the water supply does not conform to potable water standards.

6. Repairs to High Pressure System, Various Facilities..... 550,000

This project provides for the repairs to the high-pressure gas and hydraulic systems that serve the Hypersonic CF_4 Tunnel (1275), the 6x28-inch Transonic Tunnel (583), the 6x19-inch Transonic Tunnel (585), the 7-inch High Temperature Tunnel (1264), and related systems in the west area. Work includes the replacement of defective piping, valves, welds, and post-repair radiographic inspection of the welds. This system has been inspected under the Center's recertification program and the repair work is essential to ensure the safe and efficient operation of these research facilities.

H. Lewis Research Center LeRC..... $3,400,000

1. Repair Process Air Systems..... 560,000

This project consists of the repair for recertification of process systems. The work includes repair of deteriorated process air system piping, supports, expansion joints and other related components at various locations in the 54-inch diameter supply mains. Normal wear/corrosion of piping and components in the process air system has resulted in conditions which require repairs/replacement to ensure structural adequacy and continued safe operating conditions. The process air systems are critical to the successful accomplishment of research tasks at LeRC. This work is now necessary to preserve system safety, integrity, reliability, and availability.

2. Repair Unit Substation Transformers, Engine Research Building (ERB) (5)..... 415,000

This project provides for the replacement of eight unit substation transformers located in the Engine Research Building (5) Complex. The work includes removal of the existing transformers, purchase and installation of the new units, and necessary wiring and switching modifications. The existing transformers are more than 40 years old and are reaching the end of their useful life. Due to their construction, it is virtually impossible to repair or maintain them since replacement parts are no longer available.

3. Replacement of Fire Protection System, Various Locations..... 690,000

This project provides repairs to the existing Proprietary Protective Signaling System (PPSS) Fire Protection System. The scope of work consists of the following tasks: installing a new Central Supervising Station in Room 139, Building 21; redirecting the existing PPSS input signal wiring to 80 interface panels, removing all existing PPSS Transmitter and supervisory cabinets; replacing the existing PPSS loop cable with a new data highway cable throughout the telephone manhole system; installing a new Remote Station in the Fire Station Building 14; and rating new communication cables to link the new Remote Station with the Central Supervising Station. The present system installed in 1947 is an electro-mechanical, passive type alarm and monitoring system. It is not UL listed and does not conform to National Fire Protection Association standards. Replacement parts are very expensive and hard to obtain.

4. Repair of the 8x6 SWT Exterior Shell (39)..... 350,000

This project provides for structural repairs to the concrete shell of the 8x6 and 9x15 legs of the Supersonic Wind Tunnel Complex. Areas to be repaired include the shell sides and roof, columns, and expansion joints. Also deteriorated miscellaneous metal items and attached reinforcing steel will be repaired. The 8x6

and the 9x15 serve a wide variety of important programs. The concrete shell structure forming the bulk of the tunnel loop is deteriorating structurally and must have crack and other general repairs in order to sustain design pressure loadings.

5. Repair 40 PSIG Compressor Central Air Equipment Building (64) 695,000

This project provides for furnishing and installation of three new rotors for replacement in the 40 psig compressor unit C-12 in the Central Air Equipment Building (64). The compressor unit consists of three compressors driven by a single 16,000 hp electric motor. The compressor unit C-12 has been in service for approximately 35 years, and during that time rotor vanes have acquired numerous cracks varying in size from 1/16 inch to 2 inches. These cracks can cause catastrophic failure of the system, resulting in the possible loss of life.

6. Repair Exterior, Office Building (86)..... 690,000

This project provides for repairs to the exterior of the Office and Control Building (86) at the 10x10 SWT. Work includes removal of existing windows; installation of a new double-glazed window system; sealing and painting, and other miscellaneous architectural work. The windows in the Office and Control Building (86) no longer provide an effective barrier from the outside weather for the building, equipment, and occupants. The repair, additionally, will result in an energy savings of approximately $3,200/yr in steam generation costs.

I. Marshall Space Flight Center (MSFC). $1,680,000

1. Repair Pressure Vessels..... 700,000

This project provides for repair of structural discrepancies in 16 pressure vessels. The work includes inspection, shipment to a repair facility, documentation of repair and testing, return, installation and cleaning to present-day standards. These are small high-pressure air, nitrogen, and helium vessels used as part of the overall large-volume high-pressure gas system that supports various programs. Loss of this storage capacity would adversely affect test programs.

2. Repair High-pressure Piping... 720,000

This project provides for the repair of high-pressure systems including replacement of piping and components that have deteriorated or exceeded their expected lifetime. This effort includes replacing approximately 8,450 feet of high-pressure air piping and approximately 4,950 feet of GN2 piping. These

systems were installed in the 1950-1960 timeframe and have deteriorated with age and heavy cyclic use. Failures and defects in the systems are being corrected by "breakdown" maintenance. Much of the hardware is obsolete, deteriorated, and in need of repair. These systems support major test programs at MSFC.

3. Repair Roads and Paved Areas..... 260,000

This project provides for the repair and/or resurfacing of approximately 82,000 square yards of deteriorated roads, parking areas, and hardstands at MSFC. The work consists of repairing damaged base courses, application of tack coats, overlaying with asphaltic concrete and/or a seal coat, and painting parking stripes. Roads, parking areas, and hardstands at MSFC are reaching a critical point where base failures are occurring because moisture penetrates the pavement through cracks. It is essential that these paved areas be resurfaced so that they will be safe for vehicle movement.

J. Michoud Assembly Facility (MAF)..... $1,330,000

1. Repair Fire Alarms, Various Buildings.. 610,000

This project provides for repair of the fire alarm systems in various building as follows: replacement of defective system components (panels, transmitters, etc.) and redistribution of alarm horns in Buildings 320, 350 and 351; and replacement of systems in Buildings 127, 213, 220,301, 303, 420, 421,and 422. Buildings 320, 350 and 351 have pull-box, horn-activated type alarms that are over 20 years old. The existing system is no longer manufactured and spare parts are not available. Other problems exist, e.g., many horns need redistribution because of layout changes. All building systems wil be replaced.

2. Repair Building 102..... 720,000

This project provides for replacement of transite ductwork and chilled water piping, insulation and accessories that support five HVAC units in Building 102. System testing and balancing are also included. Building 102 houses office personnel and computer hardware. The building is over 40 years old and no major rehabilitation of its utility systems have been performed. Recent engineering studies have recommended replacement of transite ductwork which has collapsed in various locations.

K. National Space Technology Laboratories (NSTL). $1,415,000

1. Repair of Industrial and Potable Water System..... 235,000

This project provides for the replacement of approximately 1,400 linear feet of deteriorated cast iron supply piping in the industrial water system that supplies deflector cooling water and deluge fire protection to the Space Shuttle Main Engine (SSME) test stands. Replacement of damaged drive staffing and deep well turbine pumps also will be accomplished. This project also will provide for the repair of the interior coating and cathodic protection system in the two 300,000- gallon elevated potable water storage tanks that have deteriorated due to age and corrosion. Installation of two new pumps, a drain system, and manways will also be accomplished on the potable water system.

2. Repair of HVAC Control Systems..... 680,000

This project provides for the repair and replacement of the aging air delivery systems, controls, mixing boxes, and related components in Building 1100, Administration Building; Building 1105, Environmental Laboratory; and Building 8100, Instrumentation Laboratory. Repair and replacement of these components which provide environmental control to the office and laboratory areas is necessary to reduce energy consumption, operating and maintenance costs, and to replace existing control components that are old and difficult to replace. Many of the controls do not function and it has been necessary to add filter media on many supply air diffusers to trap dust and trash from the ductwork due to deterioration of dampers, insulation, and interior components.

3. Repair of Roads..... 500,000

This project provides for resurface and drainage improvements of Road "N" (6,200 feet) and Road "P" (5,700). These roadways, which serve the Space Shuttle Main Engine (SSME) complex, will have failed areas removed and leveled with a thin leveling coarse, followed by a 1 1/2 inch overlay of asphalt wear surface. The existing roads are rapidly deteriorating with numerous cracks and dips indicating subsurface breakdown, checkering, and shoulder deterioration.

L. Wallops Flight Facility (WFF). $1,930,000

1. Repair of Seawall..... 600,000

This project provides for the repair of the Wallops Island seawall to protect the essential launch pads and associated facilities. The construction will be in front of and over the existing seawall. The

project will' include all necessary excavation and fill. This work is necessary to prevent or minimize storm damage to the existing seawall which is becoming increasingly vulnerable due to beach erosion and deterioration of the existing protection system.

2. Repair of Elevators..... 450,000

This project provides for the replacement of elevators in Buildings E-106, E-107, E-108, N-162, and the installation of an elevator in the Altitude Control System Laboratory, Building F-10. The existing elevators are 30 years old, io a constant need of repair and parts are difficult to obtain. This results in frequent elevator shut downs because of unsafe operations. The addition of an elevator to Building F-10 is necessary to move flight system equipment between the laboratories and testing areas.

3. Repair of Research Aircraft Area..... 550,000

This project provides for the repair and resurfacing of the research aircraft ramp areas northeast, east, and southeast of Hangar N-159. These outlined areas are primary ramp locations that have deteriorated to the extent that broken pavement presents a Foreign Object Damage (FOD) hazard to aircraft and associated personnel. Hangar N-159 ramps are also utilized by various Langley and Ames aeronautical research programs. Preservation of these areas is considered essential for operational safety.

4. Repair of Paved Areas at National Scientific Balloon Facility, (NSBF), Palestine, **Texas**..... 330,000

This project provides for the repair and resurfacing of the balloon launch pad "finger" roads, peripheral road, access road, various parking lots, and support area pavements. The total area to be repaired and resurfaced is approximately 37,000 square yards. The paved surfaces at NSBF are required to support the facility mission. The surfaces have been damaged by usage and weather and must be repaired to preclude further damage to the facility and allow continued support to balloon launch operations at NSBF.

M. Various Locations..... $200,000

1. Repair of Roads and Parking Areas, Madrid, Spain..... 200,000

This project provides for the patching, repair and slurry seal coating of the Madrid Deep Space Communcations Complex access road, on-site roads, area paving, parking lots, and antenna aprons. Improper flood drainage conditions will also be corrected. The asphalt paving used for the roads and area paving must be repaired and its surface renewed and sealed on a periodic basis to prevent deterioration, costly major replacement costs, and personnel hazards. Aprons must be sealed to keep water from the antenna foundations.

MISCELLANEOUS PROJECTS LESS THAN $150,000 EACH	1,265,000
Total	$27,000,000

FUTURE COST ESTIMATES FUNDING REQUIREMENTS TO COMPLETE THIS PROJECT:

An estimated $27,000,000 to $30,000,000 per year will be required for the continuation of this essential repair program.

REHABILITATION AND MODIFICATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

REHABILITATION AND MODIFICATION

Summary of Project Amounts by Location:

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Rehabilitation and Modification of Facilities, Not In Excess of $750,000 Per Project

INSTALLATION: Various Locations

FY 1989 CoF Estimate: **$34,000,000**

FY 1987: $30,972,000 FY 1988: **$32,000,000**

COGNIZANT INSTALLATIONS/LOCATIONS OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for the rehabilitation and modification of facilities at NASA field installations and Government-owned industrial plants supporting NASA activities. Included in this request are those facility rehabilitation and modification needs for FY 1989 that have been fully identified at the time of the submission of these estimates and are estimated not to exceed $750,000 per project. The purpose of this program may include some restoration of current functional capability but also includes enhancement of the condition of a facility so that it can more effectively accomplish its designated purpose or increase its functional capability..

PROJECT JUSTIFICATION:

Based on the initial investment costs, the NASA Capital Type Property totals approximately $7.7 billion (September 30, 1986), of which the physical plant comprises some **$4.0** billion. A continuing program of rehabilitation and modification of these facilities is required to accomplish the following:

a. Protect the capital investment in these facilities by minimizing the cumulative effects of wear and deterioration.

b. Ensure that these facilities are continuously available and that they operate at peak efficiency.

c. Improve the capabilities and usefulness of these facilities and thereby mitigate the effects of obsolescence.

d. Provide a better and safer environment for all personnel.

This program includes only facility rehabilitation and modification work having an estimated cost not in excess of $750,000. The work is of such a nature and magnitude that it cannot be accomplished by routine day-to-day facility maintenance or by related routine facility work efforts that are provided for in other than CoF estimates.

PROJECT DESCRIPTION:

Proposed rehabilitation and modification projects for FY 1989 totaling $34,000,000 are described under "PROJECT COST ESTIMATE." The total program of $34,000,000 has been distilled from requests of approximately $58,000,000 and represents only a modest request in relation to the backlog of this type of work. Based on relative urgency and expected return on investment, the projects which comprise this request are the highest priority requirements. Deferral of this mission-essential work would adversely impact the availability of critical facilities, program schedules, and energy conservation objectives. Only those projects estimated to cost less than $150,000 have not been individually described or identified by center. The total cost of these miscellaneous projects is $1,410,000.

During the course of the year, some rearrangement of priorities may be necessary. This may force a change in some of the items to be accomplished. Any such change will be accomplished within available resources. The following broad categories of work are described further in the "PROJECT COST ESTIMATE:"

a.	Utility Systems	12,390,000
b.	Fire Detection/Protection Systems	2,225,000
c.	General Purpose Buildings	7,095,000
d.	Technical Buildings/Structures	11,310,000
e.	Pavements and Drainage	980,000

PROJECT COST ESTIMATE:

A. Ames Research Center (ARC)... ..... $1,690,000

1. Rehabilitate the High-pressure Air Distribution System... 575,000

The high-pressure air distribution system was installed over 25 years ago and serves all major Ames research facilities. During subsequent years, piecemeal additions were made resulting in a system that has no central monitoring and control station and no control and monitoring devices within individual using areas. This project will provide mods to piping, and valves, and will provide upgraded control and monitoring electronics to connect four major high-pressure air users to the central station. Building systems included in this project are located at N218, N221, N222, N226, and N248. Additionally, this project provides for tie-in of new localized controls at all locations into the new central control and monitoring station.

2. Modifications for High-pressure Air to the 80x120-ft Wind Tunnel Test Section..... 655,000

This project provides for the extension of the existing high-pressure air line to the test section of the 80x120-ft Wind Tunnel and for the installation of heaters, valves, and controls to be located in a new 475-square foot pre-fab control building under the tunnel superstructure. The new 3000 psig air line will be 4 inches in diameter and will be routed underground approximately 1000 ft from the existing high-pressure air supply. The high-pressure air supply is required for propulsion and cooling of models to be located in the test section, and for thrust augmentation on powered lift and rotary wing models. Without this new air supply, portable equipment must be used which is less productive and has a higher risk for failure.

3. Modifications for a Videoconference Center (N-200)..... 225,000

This project will modify approximately 1600 square feet in the basement of N-200 for a new videoconference center. Five existing rooms will be converted into four functional areas: conference room, control room, reception area, and storage. Modifications include new walls, vinyl floors, computer floor, ceilings, and mechanical/electrical modifications as required. No facility now exists at Ames suitable as a permanent videoconference area. A facility of this type is needed to allow short leadtime scheduling and to ensure that agency standards are met in support of videoconference activities.

4. Modifications for Safety (N-227D) 235,000

This project provides for the acoustical treatment of pipes, valves, and walls at Building N-227D. Currently the noise levels exceed the maximum allowable per the Occupational Health and Safety Act (OSHA). Approximately 12,000 square feet of piping surfaces and valve bodies will be acoustically wrapped to attenuate

high noise transmission. Also, the control room will be modified to improve the noise levels. Modification includes new sound-rated doors, better windows, and a higher acoustic level ceiling.

B. Dryden Flight Research Facility (DFRF)..... $390,000

1. Modification of the Data Analysis Facility (4838)..... 390,000

This project provides for the electrical and mechanical modifications necessary to meet the current and projected near-term occupancy requirements for computer and office automation equipment. Modifications include new breakers, switchgear, large cables, panels, and a new 110-ton chiller with associated pumps, valves, and piping. The existing mechanical and electrical system in the building are fully loaded. Although floor space is available for the new equipment, the building support systems must be increased to allow connection of new data analysis equipment.

C. Goddard Space Flight Center (GSFC).. $3,010,000

1. Modification for Cryopumps in the Optical Thin Film Facility (5)..... 340,000

This project provides for conversion of three vacuum oil diffusion pump facilities in the Optical Thin Film Facility of Building 5, to Cryopumping Systems. Work includes the removal of liquid nitrogen traps, diffusion pumps, mechanical pumps, controls, valves, and associated equipment. Also included is modification of the existing pumping port and base plate to accommodate a new vacuum valve, cryopump, mechanical pumps, controls, and associated equipment. The proposed upgrading of the antiquated diffusion pumps will eliminate the risk of contamination by the back streaming of oil particles onto flight payloads instruments. The replacement of mechanical pumps and related hardware will improve the working environment due to substantial reduction in acoustic noises, and will also enable the excessing of an old liquid nitrogen pressure vessel trailer.

2. Modification of Detector Fabrication Facility..... 650,000

This project provides for modifying existing laboratories in the Applied Sciences Laboratory, Building 11 into clean rooms. Rooms S15 and S17 will be converted into class 100, while rooms S19 and S19A will be converted into class 1,000 clean rooms. Work includes the installation of High Efficiency Particulate Air (HEPA) Filters, ceiling, door gaskets, supply and exhaust systems, sticky mats, signs, warning lights, gas monitors, and deionized water monitors. Also included is the sealing of air ducts and openings around minor architectural modifications, and general painting as required. This facility has the capability for developing and fabricating advanced detectors and integrated circuitry in direct support of current and future space science projects. As requirements for high-density, high-speed electronics and high-sensitivity detectors become the basis for new instruments, the quality of facilities to fabricate these devices must be

improved primarily to achieve ultra clean and precisely ventilated laboratories. Dust particles can destroy the effectiveness of small delicate devices and therefore cleanliness becomes a foremost consideration and is critical to performance.

3. Modifications to Health and Environment Unit (5 and 97)..... 740,000

This project provides for the modification of 8,200 square feet of the Plant Maintenance Support Facility, Building 97 to accommodate the Goddard Health Unit and Environmental Health Staff which is to be relocated from the Instrument Construction and Installation Laboratory Building 5. In addition, this project will also provide for modification of 5,100 square feet of vacated area in Building 5 to accommodate the electromechanical laboratory/computer facility. The relocation of the existing Health Unit from Building 5 is a part of a planned space utilization program that will consolidate similar functions in the same area to improve overall productivity and efficiency. The proposed Electromechanical Lab/Computer area is required to provide support for the steady increase in the in-house engineering work for flight hardware by both of the Electromechanical and Mechanical Engineering Branches.

4. Modification of Chilled Water Distribution System..... 730,000

This project provides for the modifications of the GSFC chilled water distribution system. The work includes (1) the modification of the primary/secondary system interface in 14 buildings; (2) replacement of undersized chilled water piping in Central Flight Control and Range Operations/Spacecraft Operations Facility, Buildings 3/14; and (3) the balancing of chilled water distribution system flow to all buildings. These proposed modifications to the chilled water distribution system will eliminate the present chilled water distribution and water flow control problems to these buildings and will restore the system to reliable and efficient operating performance levels.

5. Modification of Utility Control System..... 300,000

This project provides for the installation of temperature and humidity sensing elements in all major buildings at Goddard. These sensing elements will become an integral part of the Utility Control System (UCS) with capability for alarm set points at the console in Building 24. Sensing elements will be installed in laboratories and Automatic Data Processing (ADP) areas. Also included will be the software modification of the Central Computer and the Field Interface Device to allow for additional sensors and controls. Remote sensors are required to allow continuous monitoring to minimize/preclude over temperature and humidity conditions. This system provides for alarm set points for critical areas. The proposed work would result in the optimization of building monitoring and control strategies for increased energy and manpower savings.

6. Rehabilitation of Domestic Water Pumping Station..... 250,000

This project provides for the rehabilitation of Domestic Water Pumping Station 1 with the installation of two 1,000 and one 500 gallons per minute (GPM) water pumps to replace the existing three 300 GPM pumps. All supporting electrical equipment, valving, and controls will be upgraded accordingly to support the new pumps. Existing pumps were installed in the early 1960's as part of the Center's original equipment. Currently, these pumps can no longer provide adequate, reliable service to meet increased requirements. The proposed work will rehabilitate and upgrade the pumping station to support Center missions.

D. Jet Propulsion Laboratory (JPL)..... $2,010,000

1. Modification of West Area Utilities..... 580,000

This project will provide new utility lines to improve existing service, and for the routing of new underground power and communications systems on Explorer Road between Mesa and Ranger Roads, and in the area between Buildings 298, 251, and 253. Building 251 requires a connection with the communications line in Gyro and Explorer Roads in order to complete the communications circuit among Buildings 251, 253, and the remainder of the lab. The northwest area of JPL is served by a separate 16.5 kV feeder line and is metered and billed separately at higher rates than other power at JPL. This project will install conduit, cable and new tranformers so that a major step can be taken toward consolidating JPL's electric power metering and save over $1 million per year in electric service charges.

2. Modification of HVAC Systems, Various Buildings..... 720,000

This project will provide for the installation of a chilled water loop to connect three existing chillers for Buildings 168, 169, and 186 so they can be operated as if all three systems were in a central plant. The chillers and the associated equipment in these building can then be brought online as needed to match the combined cooling load of the three buildings. The cooling system for these buildings was originally designed with redundancy. Additional personnel and computer heat loads however, have caused certain areas of these buildings to be without sufficient cooling capability. This project will provide the proper capacity to all parts of these buildings and restore chiller redundancy for emergency backup capability.

3. Modification of Communications Cable Systems..... 710,000

This project provides for the installation of approximately 7000 linear feet of underground communications raceway including manholes and/or handholes. This raceway will interconnect the recently completed and planned new buildings with 28 existing buildings providing access to the communications systems, and will provide adequate spares for future connections. The systems include, but are not limited to, the instrumentation cable systems, telephone systems, security systems, fire alarm systems, Utility Control System

(UCS) and Institutional Local Area Network (ILAN). The communications network service to areas of JPL needs to be extended to provide critical services. The increasing use of computers in the scientific, engineering and management fields, as well as the overall increase in all data transmission systems, has resulted in the need for more raceways.

E. Johnson Space Center (JSC) $3,175,000

1. Modify Data Operations Laboratory (16)..... 650,000

This project modifies approximately 4,000 square feet in Building 16 to support advanced development systems primarily for Space Station applications. The work is required to accommodate and protect critical program development and support computer equipment for the data management system; guidance, navigation, and control analysis; engineering support test beds; and software language evaluation. Work includes installing fire-rated perimeter walls, a new tape library, fire detection and suppression systems, and upgrade of the electrical power and air-conditioning systems.

2. Modifications of Chilled Water Distribution System.... 700,000

This project modifies the site chilled water distribution system to correct inadequate volume and flow rates to various buildings. This project is required to meet increased cooling requirements caused by computer and support facilities growth. Work includes installing approximately 2,200 feet of underground paralleled piping, additional valves and tie-ins, and repairs to disturbed tunnel structures and area paving.

3. Modification of Fire Alarm System, Mission Control Center (30)..... 500,000

This project provides for the installation of a new state-of-the-art fire-alarm system in the Mission Control Center, Building 30. The new system will be a multiplexed system based on a central processing unit for effective fire alarm notification and management. Increasing failures, repairs, and maintenance are being experienced with the existing fire alarm panels which no longer are manufactured. Substituted critical replacement parts or special fabricated parts are not reliable.

4. Modification to Software Development Facility (12)..... 400,000

This project provides for the modification of approximately 5,400 square feet of space in Building 12 to accommodate new computer systems being installed in support of the Software Development Facility and Center Information Network computer systems. Both of these functions are critically needed to support the rapidly expanding requirements of institutional computer users at JSC. Work will include rearrangement of walls, selected computer systems, upgrade of the electrical and air-conditioning systems, and the repair and installation of computer flooring.

5. Rehabilitation of Test Power Control System (32)... 225,000

This project provides for the complete rehabilitation and centralization of the test support power control system for the large space environment chambers of Building 32, chambers A and B. The work includes installation of electrical transformer power controllers, transfer switches, and switchgear as a new centralized test power control center located on a 1200-square-foot open mezzanine extension in the high-bay area of Building 32. Cable trays, conduits, and power cables necessary to connect the power control center with the test power interfaces of chambers A and B are also included. The existing (20-year-old) systems and equipment are unreliable, inefficient, and difficult to maintain because of obsolescence and the nonavailability of parts. The centralized system will utilize current power control technology and equipment to produce improved test support reliability and operations efficiency.

6. Modifications for Advanced Avionics Systems Development (16) 700,000

This project provides for modifications to Building 16 to accommodate the new computer equipment for the Advanced Systems Development Laboratory (ASDL). Project work will consist of expanding the existing Room 2000 mezzanine and installing 1,500 additional square feet of raised flooring and a 300-square-foot variable lighting enclosure. Lighting, air-conditioning, and electrical modifications to accommodate the new area also are included. The ASDL facility will provide a high-fidelity consolidated avionics simulation/testing and development facility for advanced space program system including displays, controls, expert systems, telerobotics, manipulator emulations, and automation and robotics.

F. Kennedy Space Center (KSC)..... ..... $4,150,000

1. Modify Railroad Mainline..... 730,000

This project provides for improving the KSC railroad mainline by replacing the existing 100-pound bolted joint rails with a new 132-pound welded rail from milepost 7.5 to 12W. The track was originally designed for 110-gross ton cars but, since 1978, 250-gross ton Solid Rocket Booster (SRB) segment cars have been used on the rails. The track requires frequent maintenance due to fracturing of the railhead and deformation of railends downward at every joint caused by the heavy SRB segment loads.

2. Modify Building 1610, Vandenberg Launch Site, VAB..... 740,000

This project provides an integrated, bi-propellant service system which will conform to CAL/OSHA and Santa Barbara County safety standards. The scope of work includes encapsulated spill/propellant trenches and waste tank hazardous effluent capture system, improved GN_2 distribution, addition of an airlock, an emergency shower/eyewash system, ECS, plumbing and electrical appurtenances, and improved lighting. The modifications

will provide the necessary capability for controlling spills and toxic vapors necessary for propellant servicing of NOAA spacecraft.

3. Modify Underground Communications Duct Banks..... 300,000

This project provides for mechanical cleaning of existing spare ducts and installing new ducts where needed. Implementation of this project will provide adequate ducts to install cables to meet current and future needs for communications and data circuits to the Central Instrumentation Facility (CIF), Headquarters Building, Operations and Checkout (O&C) Building and Hypergol Maintenance Facility (HMF) area. The existing underground duct bank system was installed approximately 20 years ago. On recent contracts to install new communications cable, numerous problems have been encountered in installing the cables in existing spare ducts. The spare ducts are partially or completely blocked due to deterioration of the fiber (transite) duct.

4. Rehabilitate Air-conditioning System in Building AE, CAFS..... 740,000

This project will replace the "air side" of the Building AE air-conditioning system including air handling units, air distribution ducts, heating coils, controls and test/balance the new system. Ceiling repairs and asbestos removal will also be required to accomplish this project. This facility is used for payload processing and is dependent on proper control of environmental conditions, especially in the Clean Room, Telemetry and Mission Control areas. The existing air-conditioning system consists of 10 separate refrigeration systems and 16 air-handling units which have reached their estimated service life and require replacement. The new equipment will also correct the current temperature and humidity control problems.

5. Modifications to Communications Maintenance and Storage Building..... 690,000

This project will modify and refurbish the Communications Maintenance and Storage Building including HVAC systems, walls, ceiling, lighting, and tile floors. This facility is 22 years old and has deteriorated beyond restoration by ordinary maintenance. The HVAC system is insufficient, lighting is inferior, and floor space is poorly distributed for efficient operation. The modifications are required to provide economical and efficient operation of communications maintenance in support of Shuttle launches.

6. Modify Contingency Potable Water Line to HMF Areas..... 240,000

This project will install a 10-inch water line to provide a loop in the Hypergol Maintenance Facility (HMF) area for redundancy in case of a line break in the HMF area or Industrial Area. The line will run approximately 5,400 linear feet along Static Test Road between the Vertical Processing Facility (VPF) and NASA Causeway. Only one line supplies potable water to the HMF area from the Industrial Area for facilities and fire hydrants. This line is a single failure point in the water supply and its failure would result in a

shutdown of a, portion of HMF operations. Such a shutdown would suspend operations in the VPF, SAEF-2, and Cargo Hazardous Servicing Facility.

7. Rehabilitate Chilled Water Pumps, LC-39 Utility Annex..... 360,000

This project removes four obsolete chilled water pumps in the Utility Annex and replaces them with pumps and motors of 10 percent more capacity and variable speed controll. This chilled water system supports Shuttle processing and launch operations and must maintain reliable HVAC service. Three of the pumps are 25 years old and the fourth is one-half the capacity of the others. Chilled water requirements for the Orbiter Processing Facility, Vehicle Assembly Building, and Launch Control Center have increased and existing pumps are no longer adequate. New mounting pads, adjacent piping and valves will also be installed.

8, Modify Fuel Storage Area #1 GN2 System, Cape Canaveral Air Force Station (CCAFS)..... 350,000

This project will upgrade the GN2 Distribution System at CCAFS Fuel Storage Area No. 1 by replacing 12 regulating panels, adding two new panels, and adding up to 6000 feet of associated piping to service the drum storage area and the hydrocarbon fuel storage area. The existing GN2 regulating panels need to be upgraded to include the latest safety devices and to support revised operational requirements for projected future use. The CCAFS Fuel Storage area is operated by KSC and is used for off-loading and on-loading various fuel commodities to and from storage drums, liquid tankers, refuelers, and carts.

G. Langley Research Center (LaRC)..... $3,215,000

1. Rehabilitation of HVAC Computer Complex (1268 and 1268B)..... 740,000

This project provides for the rehabilitation of the heating, ventilating, and air-conditioning systems in the computer complex, Buildings 1268 and 1268B. The work includes the removal of eight air handling units and replacing with 15-ton chilled water air-conditioning units and all related work in the computer room on the second floor of Building 1268. A 400-ton absorption chiller will be installed in Building 1268B with associated equipment. The installation of the chilled water computer room air-conditioning units will provide a high degree of reliability and flexibility as computer configurations are changed. The new absorption chiller will increase the reliability, extend equipment life, and optimize energy utilization.

2. Modifications to Acoustic Laboratories (1221A)..... 710,000

This project provides for the modifications to the acoustic laboratories (1221A) for continuing support for the acoustic observables program. Work includes the modifications to the Jet Noise Laboratory to relocate exhaust equipment for more efficient operation. The entrance will be relocated and enlarged to improve model and instrument installation. The work also includes the construction of 24-foot wide and 64-

foot long addition to Building 1221A to provide space for the Thermal Acoustic Fatigue Laboratory. The addition will be constructed with concrete foundation and floor slab, structural steel frame, insulated metal siding, and will include electrical power, HVAC, and fire protection systems. These modifications will upgrade the laboratories to increase productivity and data quality on the behavior of structures within the intense acoustic environment of high-performance aircraft and space transportation systems.

3. Rehabilitation of Low-Turbulence Pressure Tunnel Facility (582 and 582A)..... 570,000

The project provides for the rehabilitation of 6000 square feet of space in the Low-Turbulence Pressure Tunnel Facility, Buildings 582 and 582A. Work in Building 582 includes new walls, flooring, ceiling, electrical power, heating, and air-conditioning systems for offices and a control room. The rehabilitaton of Building 582A includes new office and rest room facilities. The rehabilitation of these 40-year old buildings is required to provide a satisfactory environment for research personnel and equipment and to ensure the continued integrity of the building systems.

4. Modifications to the 0.3 Meter Transonic Cryogenic Tunnel (1242)..... 530,000

This project provides for the modification to the liquid nitrogen (LN_2) supply system serving the 0.3 meter Transonic Cryogenic Tunnel, Building 1242. Work includes replacing the LN_2 piping and valves with stainless steel vacuum-jacketed piping and valves. The two LN_2 storage dewar vessels will be repaired and reinsulated with the supply pumps and controls replaced. The modification to the liquid nitrogen system will result in better working conditions for operations personnel, increase tunnel productivity and reduce operating costs.

5. Rehabilitation of Jet Exit Test Facility (1234)..... 210,000

This project provides for the rehabilitation of the Jet Exit Test Facility, Building 1234. Work includes replacing the pneumatic air pressure controls, installing acoustical wall treatment and a suspended ceiling in the control room, recessed lighting, HVAC, and fire alarm systems. This facility is over 40 years old and conditions are substandard. This project will improve conditions in the existing building to support aircraft populsion configurations research.

6. Rehabilitation of 8-Foot Transonic Pressure Tunnel Facility (640)..... 455,000

This project provides for the rehabilitation of the shop and equipment space in the 8-Foot Transonic Pressure Tunnel Facility, Building 640. Work will include the installation of energy-efficient doors and windows, intense walls, lighting, and rest room facilities. Building 640 is over 30 years old and deteriorated from age and use. This rehabilitation is needed urgently to maintain the integrity of the facility and to ensure its continued operation to support aeronautical research activities.

H. Lewis Research Center (LeRC)..... $3,800,000

1. Modifications of Chilled Water Plant (106 and 110)..... 475,000

This project will provide chilled water to Buildings 106 and 110. Work includes completion of an addition to Building 94 and installation of a new 600 hp chiller, pumping equipment, automatic water makeup system, piping and associated electrical equipment, and power and control wiring for the operation of the pumping equipment and chiller. This equipment will be installed in the completed addition to the Cooling Tower Pumphouse, Building 94. Also, a new 6-inch chilled water loop will be extended to Building 86. This project will provide a more efficient centralized source of chilled water for Buildings 106 and 110.

2. Modifications for Test Build-up Area, FML (203)..... 630,000

Work in this project includes modification to 2,850 square feet of existing shop area in the Fluid Mechanics Laboratory (FML) including parts cleaning, rocket assembly, and instrument checkout and calibration room; women's toilet room; a new computer room; an enlarged control room; a sensor technology lab; and an electronic shop. The project also includes the renovation of a workshop, tools/materials crib, welding booth and men's toilet room, and the construction of a 1200-square foot building addition to house a new critical parts assembly area, two offices and a conference room. Modifications to mechanical, electrical, and communication systems will be made to accommodate changes in space. Rocket engine assembly requires an area separate from the other shop areas and building activities due to delicate components and the need for a clean work environment. Without these new areas, productivity is limited because space must be shared with the fracture mechanics lab. During fracture mechanics testing, no work on rocket engine assembly can be accomplished.

3. Modifications for Low Altitude and Mach No. Testing, Propulsion System Laboratory (PSL) (125)..... 325,000

This project provides for the modification of the PSL. The work includes replacement of two 24-inch and one 48-inch by-pass valves, test cell and exhaust section vents, vents in the shop areas walls, and quick access mariways in the test cell hatches. Present operation of this facility at altitudes below 15,000 feet and mach numbers below C.4 is limited by test cell by-pass valve leakage and the possibility of test cell and exhaust section over-pressurization. New quick opening manways will allow rapid access to the test article resulting in increased productivity.

4. Rehabilitation of Substation "A" Switching (200)..... 685,000

This project provides for rehabilitation of the 138kV switching facilities at Substation A (Building 200). The work includes two new 138kV oil circuit breakers and disconnect switches; two new circuit switches; a 750 mcm cable bus tie; four new double side break disconnect switches; and protective relaying; along with necessary foundation and structural modifications. This work is necessary to correct serious deficiencies, and to better utilize the 138kV electrical power supply from the Cleveland Electric Illuminating Co. (CEI) to LeRC. The rehabilitation will help eliminate electrical stability problems between CEI and the large wind tunnel drive motors (improving system reliability and simplifying operations) and will permit LeRC to operate at a 350 MVA load level with any one of the four 138kV supply circuits or breakers out of service.

5. Modifications for Increased Exhaust Air Flow, IRT (11)..... 340,000

This project will install larger diameter exhaust lines, flow measurement system modifications, and related modifications to double the existing exhaust flow capability. The exhaust lines will be increased from the existing 24-inch to 30-inch and 36-inch diameters. New flow measurement instrumentation includes pressure and temperature devices at critical locations with interfaces and equipment modules to the tunnel control system. Since larger engine inlet systems are being tested in the Icing Research Tunnel (IRT), more altitude exhaust flow capability than the existing IRT system can provide is required.

6. Modification of the Combustion Air System, South Area (202)..... 695,000

This project provides for modifications to the 150 psig Combustion Air System to provide combustion air to the Rocket Engine Test Facility (202). The work includes the purchase and installation of approximately 2300 ft. of 24-inch pipe; two remotely operated 24-inch isolation valves; a valve pit; foundations and supports; cathodic protection; and other miscellaneous work. A long-term, ongoing requirement exists for substantially improving the life of chemical propulsion space engines. The advent of satellite resupply capabilities creates a need for long-life space engines for onboard propulsion systems. In order to conduct the technology programs and evaluate engine/component life, a long duration altitude test capability is required.

7. Modification of Water Distribution System, Cooling Tower 2..... 650,000

This project will rehabilitate and modify the cooling tower water distribution system associated with Cooling Tower 2 (46) and the 8x6 and 9x15 SWT (39). This project provides for the removal and replacement of the severely deteriorated underground supply and return cooling tower water lines of various sizes between 4 and 30-inch diameter, drainage pipe, and expansion joints necessary for the interconnections with the cooling tower water distribution system of Cooling Towers 3 and 6 (70 and 126). Cathodic protection also will be provided. Operation of the 8x6 SWT and the Propulsion Systems Laboratory are dependent on cooling water from

Tower 2 and Tower 6 respectively. This project will interconnect the two systems such that each tower can be used to serve any of the systems should an emergency arise.

I. Marshall Space Flight Center (MSFC)..... $3,560,000

1. Modifications for HVAC System (4707)..... 635,000

This project provides environmental controi for the north half of Building 4707 (approximately 40,000 square feet). Work will consist of installing chillers, piping, cooling towers, air handlers, associated electrical service, utilities control system, insulation and a 750-square foot equipment room. The north high bay of Euilding 4707 houses the process/productivity activities that utilize robotic and electronic equipment which is designed to operate in a conditioned environment. The new cooling equipment provided by this project will allow personnel and equipment to operate under proper environmental conditions.

2. Modifications for Interface Verification/Simulation (4705)..... 730,000

This project provides for the modification of Building 4705 to establish Space Station Interface Verification/Simulation Facility (IVSF). Modifications include converting existing high bay and side room floor space to support buildup, outfitting, servicing, and interface verification of standard and non-standard flight racks. The facility must meet general overall cleanliness requirements of 100K with a dedicated area approximately 20 feet x 20 feet at. a 10K level. Flight simulated utilities for electrical power and process fluids/gases such as helium, nitrogen, and oxygen are required. In addition, hazardous materials, such as mercury, will be used and provisions for handling materials that may have biological constraints will be provided. There is currently no facility at MSFC that can supply all of these requirements and, without this project, MSFC could not meet current Space Station design responsibilities and commitments.

3. Modifications for Module Subsystems Test Facility (4755)..... 700,000

This project provides for the modification of the existing Module Subsystems Test Facility located in Building 4755 by expanding and upgrading the Environmental Control and Life Support System (ECLSS) component development testing capability. Modifications include expanding and enclosing the test area floor space and providing work benches/cabinets, sinks, a vent hood, and work islands with electrical power, chilled water and gas distribution. Air handling/conditioning equipment necessary to maintain a controlled, 100K clean environment in the test area will also be provided along with a vacuum pump and ullage system. Existing office space on the first floor of the center bay will be modified to provide environmentally conditioned computer support and control rooms to support ECLSS and Common Module Integration Simulator (CMIS) test operations. The capacity of the building's existing uninterruptible power supply will be increased. This project is necessary to upgrade the facility to support evolving Space Station module subsystems testing requirements which requires a properly outfitted and sophisticated laboratory environment.

4. Modifications for Redundant Chilled Water Capacity (4663)..... 595,000

This project provides for the purchase and installation of a 750-ton chiller, cooling tower, piping system, and associated electrical power and controls/instrumentation for the chiller system in Building 4663. Computer hardware currently housed within Building 4663 is mission-critical. The Huntsville Operation Support Center (HOSC) provides mission support for Shuttle operations while the Payloads Operation Control Center (POCC) provides mission control for Spacelab missions. The cooling equipment for Building 4663 utilizes a 420-ton chiller and a 550-ton chiller. Two hundred tons of chilled water redundancy has been added. Total redundancy is necessary to ensure continuation of a mission should a major failure occur in one of the prime chillers.

5. Modifications for Straylight Test Facility (4487)..... 680,000

This project provides for modification of Room BC142, Building 4487, to increase the size of existing Straylight Test Facility from approximately 400 square feet to 900 square feet. A 40-foot section of the existing 100-meter long vacuum tube will be increased from 4 feet to 10 feet in diameter. Electrical power, water, HVAC, air, controls and instrumentation will be installed as required. This facility is presently being used for testing of straylight suppression methods. Larger future payloads will demand a larger vacuum tube. Full-scale straylight testing will greatly enhance the success of optical sensor/cameras used on missions such as the Hubble Space Telescope. This facility will be used to support present missions and provide a means to aid research and development for all future missions.

6. Modifications for Emergency Power for Payload Crew Training Complex (PCTC) (4612) 220,000

This project provides for the installation of an emergency power generator with automatic transfer switching. Two self-contained cooling units, with necessary valving to utilize existing chilled water plant for backup, will be installed. An enclosure for outside equipment protection will be constructed. During simulations, numerous personnel in operational positions depend on the PCTC data to train STS/Spacelab mission support personnel. In the event of a loss of power during a simulation the crew training and testing activities are interrupted and recovery takes over 2 hours. In addition, loss of power to all computer cooling equipment can further delay critical operations.

J. Michoud Assembly Facility (MAF)..... $2,010,000

1. Modifications to Substation (350)..... 650,000

This project provides for installation of a new 3000-kVA double-ended substation, switchgear, feeder cable and support foundation at Building 350 to meet projected electrical demand. Redistribution of some

electrical loads from two existing substations is also included. Building 350 houses various office personnel and numerous computers. Four existing double-ended substations (30-33) are inadequately sized to support today's power requirements. A consultant study of long-term demand/supply needs shows (1) substations 30 and 31 are operating over capacity (145%); (2) substations 32 and 33 are operating near capacity (85%); and (3) planned additional computer hardware growth will further increase demand problems. The study strongly recommends that to meet the projected loads a new separate substation must be installed to support computers and redistribute some existing loads to equalize remaining demands.

2. Modify Electrical Power Feeders 620,000

This project provides for installation of a new 500-MCM 13.8-kV Feeder, switchgear and related accessories to reduce the high electrical demand of existing Feeder #17/31. Some loads on Feeder #17/31 will then be redistributed to the new Feeder. The existing feeder serves many critical buildings and facilities (e.g., 175, 318, 350) at MAF. Planned additions such as the Industrial Wastewater Treatment Facility and new computers in Building 350, will overload the feeder's supply capability. An analysis of the situation recommended installation of a new high-voltage Feeder and then distribution of loads on both feeders could be equalized.

3. Rehabilitate Drainage for Manufacturing Building (103)..... 740,000

This project provides for rehabilitation of existing lateral concrete drain lines that transport rainfall out of the main External Tank Manufacturing Building 103. Specifically, the work includes inspecting and sealing of joints and the addition of several new laterals where needed to improve flow discharge. Several deluge rainfalls in the last 10 years have shut down production and caused up to 6 inches of flooding to critical equipment such as the 27-foot boring mill. Several studies of system inadequacies recommended various improvements including repair of all drain lines.

K. National Space Technology Laboratories (NSTL)..... ..... $1,910,000

1. Modification to Test Complex B Heating System..... 600,000

This project is required to improve the operating efficiency of the High Temperature Hot Water (HTHW) generation system for the Space Shuttle Main Engine (SSME) test area. The existing HTHW generators are oversized for the present load and operate inefficiently at low-firing rates. This low rate of operation reduces the control span and the operating systems are no longer sensitive enough to maintain effective control. This project will correct this situation by providing a low temperature hot water system for space heating and reheating facilities within the Complex B test area. The work will include the installation of a new boiler in the Test Control Center, Building 4210, the pumps necessary to move the hot water through 1,755

linear feet of new insulated supply and return lines to the test stand B-1 and B-2. This project also will provide for the installation of 2,000 linear feet of natural gas pipe and all necessary ancillary equipment for the safe and efficient operation of the system.

2. Rehabilitation of Technical Support Building (S-2436) 345,000

This project provides for general rehabilitation of approximately 10,000 square feet to Building 2436. This building has been in use for 24 years and its condition has deteriorated and is in need of rehabilitation The HVAC system requires constant repairs to maintain operation because the equipment has surpassed its life expectancy. The electrical services to this facility are overloaded. Many circuit configurations do not meet the electrical code. The interior finishes, such as the ceiling system, are coming apart due to age and the roof leaks. Work will include new suspended ceiling, new wall covering, floor covering and insulation. HVAC modifications will include the replacement of 13 old and deteriorated split system air-conditioning units with a new energy-efficient central chiller system and fan/coil air distribution system. Electrical and lighting modifications also will be accomplished to comply with the latest electrical standards.

3. Rehabilitation of Warehouse (2204).. 225,000

This project provides for general rehabilitation of approximately 7,000 square feet of interior space on the first and second floors of Building 2204. The existing space is being used as offices and technical electronics laboratory by the technical support contractor. The space is deteriorating from age and the present environmental system does not provide adequate humidity and temperature control for repair of printed circuit boards. Work includes the installation of new suspended ceilings, wall covering, rest rooms, and upgrade of the air-conditioning and lighting systems.

4. Modify High-Temperature Hot Water Generating System..... 740,000

This project provides for the installation of natural gas fired hot water generators in the Laboratory and Engineering Complex of the National Space Technology Laboratories (NSTL). Modifications will be made to the following building heating systems: Building 1000, Data Handling Center; Building 1002, Navy Oceanography; Building 1100, Administration; Building 1105, Environmental Laboratory; and Building 8100, Instrumentation Laboratory. This project removes these buildings from the central high-temperature hot water (HTHW) distribution system to improve operating efficiency. This project will permit the shutdown of inefficient HTHW distribution by providing a stand-alone system for these facilities.

L. Wallops Flight Facility (WFF).. $1,710,000

1. Modifications to Building Elevations and Transformer Pads on Wallops Island..... 600,000

This project provides for the raising of floor levels in Service Shop and Storage Building X-35 and Equipment Storage Building W-22, and the raising of transformer pads on the north and south ends of Wallops Island. The facilities listed are used in rocket/payload checkout and assembly operations. Due to the deterioration of the seawall and the subsequent increased frequency of flooding on Wallops Island, these structures must be raised to avoid damage from tidal flooding.

2. Modification of Central Cooling System... 380,000

This project provides for the modification and replacement of major componets of the central chilled water system at WFF that serves Buildings E-104 through E-108, and Building N-159. The facilities house the Management Education Center, Launch Control Center, and the major administrative and engineering offices. Loss of this central system would severely affect the utilization of these facilities. The existing 300-ton and 100-ton chillers are both over 25 years old. The project will provide for replacement of the existing chillers with two 200-ton helical screw chillers and one 100-ton reciprocating chiller. Pumps, piping, valves, and controls will be replaced and/or modified to provide a dynamically balanced system.

3. Rehabilitation of Telecommunication Facility, (F-2)..... 350,000

This project provides for the rehabilitation of Building F-2 by replacing floor ceiling tiles; installing insulation and wallboard in exterior walls, insulating above the ceiling, thermal windows, metal exterior doors, HVAC systems, and fire protection systems; minor repair of exterior walls and fascia; and the construction of a security vault adjacent to the building. Building F-2 was built in the mid 1940's, it has had minor floor plan changes and new roof in 1984. This work is necessary to provide greater energy efficiency and reduce heat loss caused by lack of or deteriorated insulating systems. HVAC system is to replace steam-supplied heating and window unit air-conditioners. Other changes are to improve safety conditions due to the lack of, or deteriorated, systems. The security vault is to house datafax and cryptographic transmissions.

4. Rehabilitation and Modification of Storm Drainage System..... 380,000

This project provides for the rehabilitation of 40 drop inlets with cast in-place or pre-fabricated reinforced concrete units on Wallops main base; the installation of two culverts with flood gates and check valves on Wallops Island; and the construction of a dike on Wallops Island. The existing drop inlets on the

main base are over 40 years old and are in a state of severe deterioration. Many have collapsed causing erosion due to the resultant uncontrolled storm water and creating a safety hazard. The culverts and dike will assist in control of tidal flooding on Wallops Island.

M. Various Locations..... $1,960,000

1. Modification of DSS-14 Operations Support Building G86, Goldstone, CA 630,000

This project provides for structural strengthening of the building and bracing of all associated building electrical and mechanical equipment. The modifications include reinforcing roof diaphragm-to-wall connections, strengthening of concrete block shear walls with a reinforcing steel and concrete laminate, improved bracing of equipment to building shear walls, and modification of equipment-to-foundation interfaces. The Goldstone Deep Space Communications Complex is located in Zone 4 the highest risk area as rated by the Uniform Building Code. Collapse of this building could result in severe injury or loss of life to station personnel and costly damage to extremely sensitive and critical electronic equipment resulting in loss of spacecraft communications capability for periods up to 2 years.

2. Modification of 34-Meter Antenna for X-Band Uplink, DSS 15, Goldstone, CA..... 530,000

This project provides for the modification of **DSS** 15 antenna, and will include a second environmentally controlled azimuth axis mounted electronics support room complete with access stairs and platforms. This room will provide space for the X-band transmitter equipment and associated systems. Fire protection and utilities services are also included. This project is required in order to provide X-band transmit capability on the DSS 15 antenna to support the Magellan Project.

3. Modification of 70M Antenna for X-Band Uplink, **DSS-14,** Goldstone, CA..... 300,000

This project provides for the modification of the 70-meter antenna for X-band transmit capability. Included is the fabrication of a new Deep Space Station standard feed cone shell and the modification of associated utilities and safety systems. The existing electronics-filled feed cone will be replaced with the new X-band cone, together with all required alignment, testing and documentation. This project is required to meet the command X-band communications requirements for the Mars Observer Spacecraft project.

4. Modifications of Building G-33, Goldstone, CA..... 500,000

This project provides for the structural strengthening and building equipment bracing necessary to bring the building into compliance with the recommended levels of the currect Unified Building Code for seismic safety for a Zone 4 classification, the highest risk zone. This project includes additional bracing of the roof-to-wall support connections, strengthening of concrete block shear walls, and modification of

equipment foundations and equipment supports. The existing building does not comply with current building standards for personnel safety in a zone IV sensitive area. Without modifications the building could collaspe during an earthquake resulting in loss of life and extensive equipment damage.

MISCELLANEOUS PROJECTS LESS THAN $150,000 EACH.....	$1,410,000
TOTAL	$34,000,000

FUTURE CoF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

An estimated $34,000,000 to $38,000,000 per year will be required for continuing rehabilitation and modification needs.

MINOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

MINOR CONSTRUCTION

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	$ 450.000	CF 11-2
Dryden Flight Research Facility	485.000	CF 11-3
Goddard Space Flight Center	480.000	CF 11-3
Jet Propulsion Laboratory	950.000	CF 11-3
Johnson Space Center	830.000	CF 11-4
Kennedy Space Center	1.460. 000	CF 11-4
Langley Research Center	975.000	CF 11-5
Lewis Research Center	930.000	CF 11-6
Marshall Space Flight Center	725.000	CF 11-7
National Space Technology Laboratories	760.000	CF 11-7
Wallops Flight Facility	730.000	CF 11-8
Miscellaneous Projects Not Exceeding $150.000 Each	225.000	CF 11-9
Total	$9.000. 000	CF 11-9

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Minor Construction of New Facilities and Additions to Existing Facilities, Not in Excess of $500,000 Per Project

INSTALLATION: Various Locations

FY 1989 CoF Estimate: $9,000,000

FY 1987: $7,000,000 FY 1988: $8,000,000

COGNIZANT INSTALLATIONS/LOCATIONS OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for minor facility construction at NASA field installations and Government-owned industrial plants supporting NASA activities. Each project included in this program is estimated to cost not more than $500,000 and involves either the construction of new facilities or additions to facilities. The FY 1989 request of $9,000,000 will improve the usefulness of NASA's physical plant by changing the utilization of or augmenting the capabilities of various facilities. Included in this request are those programmatic and institutional projects that are essential to the accomplishment of mission objectives.

PROJECT JUSTIFICATION:

The configuration of NASA's physical plant necessarily must respond to changes in utilization and adaptations required by changes in technology or in mission needs. Demands are generated by research, development, test, and similar activities. Specific justification for each minor construction project is provided under "PROJECT COST ESTIMATE."

PROJECT DESCRIPTION:

Included in the FY 1989 minor construction program are those facility projects for institutional or technical facility needs which could be fully identified at the time of submission of this budget estimate. Items of work totalling $9,000,000 are included in this resource request and have been distilled from a list totalling over $15,000,000. Projects were selected on the basis of the relative urgency of each item and the expected return on the investment. Only those projects estimated to cost less than $150,000 have not been individually described or identified by center. The total cost of these miscellaneous projects is $225,000. During the course of the year, rearrangement of priorities may require changes in some of the items to be accomplished. Such changes will be accommodated within the resources allocated.

These projects represent requirements that must be met in this timeframe to support institutional needs and programmatic objectives. The following listing summarizes the cost distribution by category of work:

a.	General Purpose Buildings..	$1,885,000
b.	Technical Buildings/Structures..	6,635,000
c.	Pavements	480,000

PROJECT COST ESTIMATE:

A.	Ames Research Center (ARC).....	$450,000
1.	Construction of Staging and Computer Supply Storage Areas (N233 & N233A).....	450,000

This project will provide two separate enclosed storage and loading dock facilities for Building N-233 and N-233A. The new structures will have a total area of 1,600 square feet and will be of concrete block construction with a plaster finish to match the adjacent buildings. Building 233A doubled the computer floor space of Building 233 without provision for magnetic tape and computer supply storage. Existing supplies are now stored adjacent to the computers which is a violation of safety rules. The existing staging area is not protected from the weather and is difficult to access with trucks. These new areas will eliminate both the need for additional storage and the need to environmentally protect the staging area.

B. Dryden Flight Research Center (DFRF)..... $485,000

1. Construction of a Consolidated Warehouse..... 485,000

This project provides for the construction of a new 13,000-square-foot warehouse facility. The new facility will be a preengineered metal building with lighting, power, and ventilation. Asphalt paving will be extended to the new building, and a loading dock with roll-up doors will be provided to facilitate movement of freight. Present warehousing at Dyrden is not adequate to meet present and future needs.

C. Goddard Space Flight Center (GSFC)..... $480,000

1. Construct Addition to Main Gate/Guard Office (9)..... 480,000

This project provides for the construction of a two-story building addition totaling approximately 4,000 square feet on the north side of the Main Gate/Guard Office, Building 9. The addition will include heating, air-conditioning, lighting, and fire protection systems, facilities for the handicapped, offices, locker areas and key shop. The Guard Office currently houses the administrative and operational functions of the security force which supports the overall mission of GSFC. The existing facility is overcrowded and does not provide sufficient space for separate locker rooms. The proposed addition will house the new security alarm equipment monitors, the Goddard Security Information System, and surveillance equipment, and will improve the reception and identification of visitors and Center personnel.

D. Jet Propulsion Laboratory (JPL)..... $950,000

1. Construction of North Lab Parking Area..... 480,000

This project provides for the construction of a parking area to accommodate 58 vehicles at the present site of Buildings 58 and 110 which are to be demolished under this project. These substandard buildings were constructed in the 1940's. All existing on-site and off-site parking areas are fully developed and utilized. There is no vacant land available for parking expansion. The construction of major new buildings has eliminated 550 parking spaces while adding nearly 1,000 employees on-site from leased space. This has caused a critical shortage of parking spaces. The project will also include paving, lighting, retaining walls, landscaping, and irrigation.

2. Construction of Addition to Building TM-17, Table Mountain Observatory..... 470,000

This project provides for the construction of a one-story 4,000 sq. ft. addition to Administration Building TM-17 at the Table Mountain Observatory (TMO) in Wrightwood, CA. This addition will consist of 12 dormitory rooms with bathroom facilties, a laundry room, an extension of the user's lounge room and an upgrade of the kitchen facilities. This project is required to house the anticipated increase in scientific investigative personnel assigned to new space observation programs made possible by the addition of 48 inch Newtonian Telescope in FY 1988. Based on an analysis of occupancy records, the existing facility is inadequate to handle the anticipated increase in personnel.

E. Johnson Space Center (JSC)..... $830,000

1. Construct Test Sample Preparation Facility (WSTF)..... 350,000

This project provides for the construction of an approximately 3,600-square-foot precast concrete structure for bonded storage and sample preparation area for spacecraft and payload test materials. The materials are currently stored in a machine shop area that does not provide the special venting required for some hazardous materials used in tests. The new facility will contain approximately 1,500 square feet of office and test sample preparation work separated by a fire-rated wall with necessary fire protection and ventilation for hazardous material storage. Rest rooms will also be provided in the facility.

2. Construct Test Fixture Storage Building..... 480,000

This project provides for the construction of an approximately 6,000-square-foot preengineered metal building to store large test fixtures and test equipment used by the Structures Test Laboratory, the ARC Jet Laboratory, and the Radiant Heat Laboratory. This facility will free valuable laboratory space and provide space for test preparation. A 3,500-square-foot concrete pad for outdoor storage will also be provided.

F. Kennedy Space Center (KSC)..... $1,460,000

1. Construct Base Electrical Shop Facility..... 490,000

This project provides for construction of an approximately 4,100-square-foot building for base lighting and electrical power shop management, engineering, and work control personnel. The building will be a precast concrete structure with finished floors, walls, and ceilings. The building services will include HVAC, rest rooms, electrical, communications, and fire alarm. Base lighting and electrical power shop management, engineering, and work control personnel are presently located at K6-1446 on Contractors Road, K6-1195

north of Saturn Causeway, and in K6-1200 in the Interim Housing Complex. This project is required to consolidate these personnel adjacent to the electrical shops located on Contractors Road to improve management, coordination, and resource utilization.

2. Construct Generator Charging and Storage Facility..... 390,000

This project provides for construction of an approximately 4,000-square-foot generator charging shed and provides approximately 4,000 square yards of pavement for storing portable generator equipment. The existing generator charging facilities are being used by the Base Operations Contractor (BOC), leaving the Shuttle Processing Contractor (SPC) with the inadequate space and facilities in K6-1995. The new generator charging shed will be built along Contractor Road adjacent to the SPC's generator maintenance facility.

3. Construct Covered Storage Area Adjacent to Support Building (M6-589)..... 220,000

This project provides for construction of an approximately 4,500-square-foot covered storage area adjacent to Support Building, M6-589, in which to store generators, blower, pumps, and tool storage bins in support of cable plant maintenance. Equipment is presently stored outside on a paved parking lot and requires extensive maintenance and overhauls due to exposure to the elements. With a covered storage area, equipment will be more easily maintained and ready to support cable modifications and repairs.

4. Construct Addition to Dispensary Building..... 360,000

This project will construct an approximately 1,670-square-foot addition to the Dispensary Building for a general purpose laboratory, an analytical chemistry laboratory, and an organic chemistry laboratory. These labs will be class 100K clean rooms requiring water, air, gas, vacuum, and instrument power. This facility will house laboratory environmental monitoring activities and associated research in conjunction with Space Transportation Systems and general center industrial activities, and includes chemistry support to Controlled Environmental Life Support System, and special biological studies.

G. Langley Research Center (LaRC)..... $975,000

1. Construction of Addition to Environmental and Space Sciences Laboratory (1250)..... 485,000

This project provides for a 4,400-square-foot, two-story addition to the Environmental and Space Sciences Laboratory, Building 1250. The addition will be constructed with reinforced concrete foundations and floor slabs, a structural steel frame, and masonry walls to match the existing construction. The building will be outfitted with electrical power, heating. air-conditioning, plumbing, and fire protection systems.

This project is required to provide an adequate work area for the Aerosol Research Branch and to consolidate personnel who are housed in separate substandard facilities.

2. Construction of Addition to Metal Technology Development Laboratory (1232A)..... 490,000

This project provides for the construction of an addition on the northeast side of the Metal Technology Laboratory, Building 1243A. The addition will provide a 15-foot clear height laboratory of approximately 3,900 square feet. Construction will be of reinforced concrete foundations, structural steel frame, and exterior masonry walls to match the existing building. Work includes electrical power, heating ventilating, air-conditioning, plumbing, and related mechanical laboratory equipment. This laboratory addition is needed for the development of advanced joining processes required to fabricate efficient structural concepts in high-temperature material for the National Aerospace Plane Program and future hypersonic aircraft.

H. Lewis Research Center (LeRC)..... $930,000

1. Construction of Addition for Model Preparation 8x6 SWT (39)..... 440,000

This project includes the removal of an existing abandoned fuel building and the construction of a new 2700-square-foot model preparation building. The building will have six model preparation areas served by an overhead crane with a 15-foot high hook height. Access into the building will be through a 14-foot high overhead exterior door. Access to the 8x6 wind tunnel will be through an existing overhead door, and through an existing pressure door into the lower balance chamber. Work will include HVAC, water, sewers, service air, electrical, and communications. Wind tunnel models have increased in complexity and are more heavily instrumented than in the past. The productivity of this wind tunnel can be increased by completing the assembly and checkout of the models prior to their installation in the test section.

2. Construction of Laboratory Addition (49)..... 490,000

This project will provide for a new fatigue-structures laboratory with a floor area of approximately 2,970 square feet annexed to Building 49. It consists of a laboratory area for hydraulic equipment with a control room for materials testing on hypersonic and advanced R&D programs. The building will be a one-story masonry building with concrete floor and steel roof framing. The concrete floor will have a continous trench to carry utilities and services. Work will include HVAC, water, sewers, electrical, and safety systems. Existing laboratory space is not adequate to support new R&D programs relative to hypersonic propulsion durability, SSME propulsion durability program, and continued expanding research related to ceramics. The new building annexed to Building 49 will share existing support services such as hydraulics, cooling water, and computer services.

I. Marshall Space Flight Center (MSFC)..... $725,000

1. Construct Entry Airlock (4708)..... 400,000

This project provides for a 70,000-cubic-foot entry airlock addition to the east entry doors into Building 4708 to facilitate movement of large payloads into the 100K clean room. Work includes new HVAC, overhead crane, electrical power and a gas piping system. The testing activity in the 100K clean room is frequently interrupted by the movement of large experiments into the area by opening the doors to the outside. This destroys the environment for a day, necessitates covering existing experiments in the area, and causes possible damage or contamination. The airlock eliminates all of these adverse conditions and provides an intermediate cleanup and wipe-down area.

2. Construct Gateway Addition (4207)..... 325,000

This project provides for the construction of an addition of approximately 2,500 square feet at Building 4207. The addition will have brick and concrete masonry walls and be architecturally compatible. MSFC has primary responsibility for the Program Support Communications Network (PSCN) which provides state-of-the-art communications services to NASA Headquarters, NASA centers, and contractor installations. This addition will allow installation of equipment to adapt to the increased demands and provide the redundancy needed to ensure no interruption of critical communications. The added space will enhance the ability to provide the required reliability and flexible communication support.

J. National Space Technology Laboratories (NSTL)..... $760,000

1 Construction of Test Support Operations Building..... 350,000

This project provides for an approximately 7,000-square-foot tilt-up concrete building on slab to house new engine support personnel and those being displaced from the B-2 Test Stand. These test support contractor personnel are required to maintain the test stand. The increased test rate will require these personnel to be permanently displaced from their present work area. The facility will include 1,000 square feet of office, 3,000 square feet of storage for mechanical and electrical ready spares and work force tools and equipment, and 3,000 square feet for staging and fabrication workspace.

2. Addition to Standards and Calibration Laboratory (8110). 410,000

This project provides an approximately 5,436-square-foot addition to the existing Standards and Calibration Laboratory, Building 8110, to house new state-of-the-art.automated, high-precision standards and calibration equipment necessary to accommodate the increased work load due to expanded SSME and other laboratory testing. Certain areas of the present facility do not provide the required dust, temperature, relative humidity,, and sound attenuation levels required for equipment calibration. The existing facility also lacks sufficient floor space, requiring laboratory instruments to be stacked on top of each other, thereby causing potential thermal instability. The addition will be environmentally controlled and will match the architecture of the existing building.

K. Wallops Flight Facility (WFF)..... $730,000

1. Construction of Integrated Control Center..... 480,000

This project provides for the construction of a new 3-level addition of approximately 5,300-square-feet between Buildings E-106 and E-107. The addition will include an aircraft control center, a range control center, and associated equipment. The project will include necessary power, lighting, and raised computer flooring, and permit the integration of aircraft control with range control for a more efficient, safer operation. The current range control center has insufficient ceiling height to allow placement of consoles for maximum visibility of range operations. Additional space is required to relieve congestion in the operational areas. The relocation will eliminate the safety hazard associated with the current control center and user personnel passing through the research aircraft hangar, or operational ramp areas, to gain the access to the range control center.

2. Construction of Support Building at National Scientific Balloon Facility, Palestine, Texas..... 250,000

This project will provide for the construction of an approximately 3,200-square-foot building to house the expanded administrgtion functions at the National Scientific Balloon Facility. The prefabricated steel building will house the administrative computer system, adequate workspace for approximately 17 people, and rest rooms. The project includes all necessary site work, utility installation, interior partitions, finishes, and electrical systems. NASA assumed sponsorship of the National Scientific Balloon Facility in October 1983. The change has necessitated increasing the scope of the Administration and Financial Management functions previously provided by the National Center of Atmospheric Research, Boulder, Colorado. This has required additional personnel and computer equipment and the current facilities are not adequate to accommodate this increase in functional responsibilities.

MISCELLANEOUS PROJECTS LESS THAN $150,000 EACH.....	$225,000
TOTAL	$3,000,000

FUTURE COF ESTIMATED FUNDING REQUIRED TO COMPLETE THIS PROJECT:

An estimated $3,000,000 to $11,000,000 per year will be required for continuing minor construction needs

FACILITY PLANNING
AND DESIGN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

SUMMARY

FACILITY PLANNING AND DESIGN

	Amount	Page No.
Regular Requirements:	12.000. *000*	
Master Planning	450. *000*	CF 12-2
Sustaining Engineering Support	1.600. 000	CF 12-2
Preliminary Engineering Reports and Related Special Engineering Support	3.000. 000	CF 12-5
Final Design	6.950. 000	CF 12-6
Other Requirements	8.000. 000	CF 12-6
Space Flight Facility Planning and Design	2.800. 000	CF 12-6
Payload Facility Planning and Design	400. 000	CF 12-6
Space Station Facilities Planning and Design	4.800. 000	CF 12-7
Total	20.000. 000	CF 12-7

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Facility Planning and Design

FY 1989 CoF Estimates: $20,000,000

FY 1987: $17,000,000 FY 1988: $16,000,000

The funds requested in this estimate are required to provide for the following advance planning and design activities related to facilities activities and projects:

a. The accomplishment of necessary development and master planning for field installations and, where not otherwise provided for, the provision of continuing engineering support and special engineering management and other services.

b. The preparation of preliminary engineering reports, cost estimates, and design and construction schedules.

c. The preparation of final construction plans, specifications, and associated cost estimates and schedules required to implement construction projects.

d. The accomplishment of facilities siting and other investigations, studies and reports, where not otherwise provided for.

Regular requirements encompass the basic purposes outlined above. The "other requirements," while also in support of "regular" purposes, cover those special needs related to large, complex projects or specific

programs considered to represent high potential future construction requirements for which early definition is essential. The large projects require more planning and longer lead time. Much of this planning must be completed prior to inclusion of the project in a budget request.

1. REGULAR REQUIREMENTS..... $12,000,000

A. Master Planning..... 450,000

Provides for update and development of existing field installation master plans. This effort includes facility studies, site investigations, and analyses of utility systems. The master plan documents will be updated to reflect as-built conditions since issue of previous plans, and to graphically represent the 5-year facility plan baseline for future development.

The NASA field center master plans are generally updated at 4-to-5-year intervals. On an agency-wide basis, the level of effort remains fairly constant. The master plans are essential as reference documents for land use planning, physical relationships of facilities, and proper orientation and arrangement of facilities. Representative candidates for FY 1989 master planning are as follows:

(1) Kennedy Space Center

An update of the facilities inventory base to reflect new construction, utility system revisions, proposed Space Station facilities and related 5-year planning.

(2) Marshall Space Flight Center

An update to reflect as built conditions of facilities and utilities, revised land use planning, and changes to 5-year planning.

B. Sustaining Engineering Support 1,600,000

Provisions for facility studies and specific engineering support continue in importance as evidenced in recent years, and must be given high priority throughout FY 1989. These efforts are important due to changing cost trends in construction materials and fuels; the continuing importance of energy conservation and efficiency; and the operation and maintenance costs for the physical plant.

The following items are included in the FY 1989 requirements:

(1) Building Research Board

Covers annual support to the Federal Construction Council's (FCC) operations and provides for special studies that the Council will perform throughout FY 1989 to help advance the science and technology of Federal Government building and construction. The FCC is subordinate to the Building Research Board, National Academy of Sciences, and its activities are supported by several Federal agencies including NASA.

(2) Utilities Services/Rates Analysis

Provides resources for the support of utilities procurement and utilities control systems. This includes, but is not limited to, technical assistance, surveillance, and recommendations with regard to utility rates, contract negotiations, systems operations, and utilities control systems. Because of the great magnitude of energy costs, these services are an annual requirement and continue to be essential.

These resources enable the agency to ensure that fair and reasonable rates are charged under its major utility contracts. Essential and valuable technical assistance is provided to our field installations *so* that effective negotiations can be conducted with utility companies. Several major utility contracts per year require technical assistance as utility contracts are renewed throughout the agency.

These and other similar utility system services are provided for by the requested resources in order to ensure technical competence and properly manage this function.

(3) Facility Operation and Maintenance Analysis

Provides for continued engineering support for implementing improvements at NASA field installations relative to manpower utilization, work control systems, preventive maintenance, facilities management and reporting systems. Improvements will also involve techniques to identify where and how increases in productivity are possible. Included in this activity are field surveys to be conducted on a priority basis at selected NASA field installations to evaluate the effectiveness of the operations and maintenance management systems.

(4) Value Engineering Cost Validations and Analyses

Provides for engineering services to improve cost-effectiveness of facility projects by subjecting project design criteria, specifications and working drawings for specific material components and

systems to a detailed independent review by engineering specialists in the particular area of involvement. Also provides services necessary to accurately predict and validate facility costs which will aid in resources planning for the various field installations.

(5) Facilities Utilization Analyses

Provides for the analyses of Agency-wide facilities utilization data covering (1) office and other types of building space; (2) designated major technical facilities; and (3) special studies comparing the utilization of technical facilities which are similar in type or capability, such as wind tunnels. Such analyses provide for (1) insights into and development of better methods of identifying underutilized facilities; (2) improved techniques to quantify level of facilities use; and (3) actions to improve facilities utilization. Work provides for review of each installation's inventory data base in support of the facilities utilization program. Surveys are necessary to validate the reported data in relation to a specific problem or need, and to assist in providing a credible foundation for plans to improve the utilization of facilities.

(6) Facility Project Implementation Handbook

Provides for the revision and publication of the Facility Project Implementation Handbook which was published in 1981 and requires update to reflect changes in legislation, organization, procedures techniques, and the state of the art. The Handbook provides the policy and guidance for management of all phases of NASA facility projects from concept through activation.

(7) Facility Engineering Handbook

Provides guidance to field installations on a standardized approach to facilities engineering. The Handbook is used as a source of basic policy and criteria for in-house engineering and work performed by architect-engineer firms. New criteria is continually being developed and/or revised. The Handbook must be modified to encompass changes in the state of the art.

(8) Energy Reduction Analysis and Support

Provides for technical and engineering support, studies, and analyses to update energy criteria, plans and directives, design methodologies, operation and maintenance procedures, research testing procedures, facility energy impacts of new programs, and the evaluation of the energy management effectiveness.

(9) Independent Analysis and Third Party Reviews

Provides the technical and engineering support, analyses, designs, and reviews required to verify, confirm and ensure suitability of construction designs or techniques relating to complex projects that involve high risk, safety or other significant considerations.

C. Preliminary Engineering Reports and Related Special Engineering Support..... 3,000,000

(1) Preliminary Engineering Reports (PER's)..... (2,450,000)

Preparation of PER's, investigations, and project studies related to proposed facility projects in the FY 1991 and FY 1992 Construction of Facilities programs are provided for by this estimate. These reports are required to permit the early and timely development of the most suitable project to meet the stated programmatic and functional needs. Reports provide basic data, cost estimates and schedules relating to future budgetary proposals. This request provides for PER's associated with proposed construction except as provided for in other requirements (paragraph 2) for Space Flight, Space Station, and Payloads initiatives.

The estimated cost of PER support for FY 1991 construction projects is $1,750,000 which will permit updating of PER's for $40-45 million in construction, and the development of new PER's for an additional $65-75 million in projects.

An additional $700,000 has been included in this line for the completion of new PER's for approximately $30-35 million of construction projects which will be high priority candidates for inclusion in the FY 1992 Construction of Facilities program. The activity associated with FY 1992 will be confined to the highest priority candidates.

(2) Related Special Engineering Support..... (550,000)

Investigations and project studies related to proposed facility projects to be included in the subsequent Construction of Facilities programs are provided for by this estimate. Such studies involve documentation and validation of "as built" conditions, survey/study of present condition of such items as roofing and cooling towers, utility plant condition and operational modes, analysis and support of environmental impact assessments and statements, and other like studies. These studies are required to allow for the timely development of projects to meet the stated functional needs and to provide basic data, cost estimates and schedules for related future budgetary proposals.

D. Final Design..... 6,950,000

The amount requested will provide for the preparation of designs, plans, drawings, and specifications necessary for the accomplishment of projects other than Space Flight, Payloads and the Space Station. Amounts required for those efforts are included under other requirements. Projects involved are planned for inclusion in the FY 1990 and FY 1991 programs. The goal is to obtain better facilities on line earlier at a lower cost.

The request will provide for final design work associated with construction proposed for the FY 1990 Program, estimated to cost $95 to $100 million, and for $15 to $18 million of high potential projects proposed for the FY 1991 program. The amount included for FY 1990 candidates and for residual requirements of this nature which have accumulated from prior years' final design activities is $5,950,000. For FY 1991, $1,000,000 is included and the supporting rationale is much the same as that set out in the PER estimate.

2. OTHER REQUIREMENTS..... $8,000,000

Other facilities planning and design requirements primarily associated with specific space programs characterized by large size, long planning cycle, and/or complexity of scope are included in this particular request. These programs require a level of planning effort and length of design time beyond the more routine facility projects. These requirements must be provided beyond the regular and most recurrent facility planning and design needs.

A. Space Flight Facility Planning and Design..... (2,800,000)

These resources provide for early and progressive design, final drawings, specifications, and site investigations for Space Flight facilities in order to ensure the best design, good cost estimates and realistic construction schedules. The Shuttle recovery and operational era requirements include expansion and improvement of Shuttle processing, repair and maintenance facilities that support the launch rate, construction of operations personnel facilities, modification to the launch complex support facilities and modifications at various locations for space engine enhancement and testing.

B. Payloads Facility Planning and Design..... (400,000)

Supporting the operational phase of the STS payloads processing program necessitates preparation of Preliminary Engineering Reports, facility site investigations, design of facility projects, and studies to determine facility processing capabilities. Included are facilities for payload operations and control payload processing for the larger payloads, as well as facility projects for logistics and maintenance of payloads and storage of associated flight and support equipment.

C. Space Station Facilities Planning and Design..... (4,800,000)

This requirement is a continuing effort primarily for preparation of preliminary engineering reports and final design drawings, specification and associated site investigation required for construction of Space Station facilities at various locations. Included are automated and robotic sciences research, space sciences research, solar dynamics simulation, crew training, processing and prelaunch checkout facilities.

Total..... $20,000,000

ENVIRONMENTAL
COMPLIANCE AND
RESTORATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1989 ESTIMATES
SUMMARY

ENVIRONMENTAL. COMPLIANCE AND RESTORATION

Summary of Project Amounts by Location:	Amount	Page No.
Ames Research Center	$1.400. 000	CF 13-3
Dryden Flight Research Facility	1.500. 000	CF 13-3
Goddard Space Flight Center	700. 000	CF 13-4
Jet Propulsion Laboratory	1.020. 000	CF 13-4
Johnson Space Center	1.400. 000	CF 13-5
Kennedy Space Center	2.000. 000	CF 13-6
Langley Research Center	1.500. 000	CF 13-7
Lewis Research Center	3.000. 000	CF 13-7
Marshall Space Flight Center	3.575. 000	CF 13-7
Michoud Assembly Facility	2.000. 000	CF 13-8
Wallops Flight Facility	300. 000	CF 13-8
White Sands Test Facility	3.500. 000	CF 13-9
Various Locations	1.200. 000	CF 13-9
Miscellaneous Projects Less Than $150, 000 Each	795. 000	CF 13-10
Studies. Assessments. and Design	2.110. 000	CF 13-10
Total	$26.000. 000	

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1989 ESTIMATES

PROJECT TITLE: Environmental Compliance and Restoration Program

INSTALLATION: Various Locations

FY 1989 CoF Estimate: $26,000,000

FY 1987: 0 FY 1988: $23,900,000

COGNIZANT INSTALLATIONS/LOCATION OF PROJECT: Various Locations

COGNIZANT HEADQUARTERS OFFICE: Office of Management

SUMMARY PURPOSE AND SCOPE:

These resources will provide for studies, assessments, design, and remedial projects for environmental compliance and restoration measures at NASA field installations and Government-owned industrial plants supporting NASA activities. The purpose of this program is to enable compliance with mandatory statutory environmental requirements and standards. The resources authorized and appropriated pursuant to this program may not be applied to other activities. The program includes such measures as studies or assessments to determine current status and options for remedial action, environmental restoration, hazardous waste removal and disposal, cleanup and closures, and removal of unsafe buildings and debris.

PROJECT JUSTIFICATION/DESCRIPTION:

Proposed environmental compliance and restoration projects for fiscal year 1989 total $26,000,000. This program represents only a modest request in relation to total requirements for environmental compliance and restoration that must be implemented within three to four years. Based on relative urgency and potential health hazards, the following listed projects are the highest priority requirements and are currently planned for accomplishment in FY 1989. Deferral of these necessary remedial measures would make it impossible for NASA to comply with environmental law and will cause shutdown of critical NASA operations by individual state or Federal environmental authorities; Studies, assessments, and design costs are approximately $2,110,000. Projects estimated to cost less than $150,000 have not been described or identified by specific location. The estimated cost of these projects is $795,000.

For those projects greater than $150.000. the following broad categories of effort will be undertaken in Fiscal Year 1989. As studies. assessments. and designs progress. it is expected that priorities may change and revisions of the activities and projects may be necessary.

a. Air Pollution Abatement and Asbestos Management $5.125. 000

b. Rehabilitation/Replacement of PCB Transformers $9.900. 000

c. Hazardous Waste Monitoring and Control $5.470.000

d. Replacement of Underground Storage Tanks..... $2.100. 000

e. Solid Wastes Disposal Facility Upgrade..... $ 6000 0

PROJECT COST ESTIMATE

A. Ames Research Center (ARC). $1,400,000

1. Replace Underground Storage Tanks, Various Locations..... 700,000

This project accomplishes the environmental actions necessary to abandon-in-place, replace, and/or monitor up to 35 underground hazardous liquid storage tanks. Tanks to be abandoned-in-place are tanks 2, 3, and possibly U1 through U6; tanks to be replaced are tanks 1,6,8,12,15,19,21,24,14,17,18,20, and 22; and tanks to be monitored are tanks 5 and 13, 8 through 11, and 25 thru 27. Many of these tanks are leaking and must either be abandoned, replaced, or monitored to comply with the latest County, State of California and Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA) Federal Laws.

2. Replace and Dispose of Polychlorinated Biphenyl (PCB) Transformers, Various Locations.. 700,000

This project provides for replacement of eight (8) PCB filled transformers located at Buildings N206A, N201, N215, N216, N218, N241 and N244. The hazardous wastes, including dielectric fluid and contaminated equipment will be disposed of in accordance with current Federal and state regulations. Equivalent sized non-PCB transformers will be installed. Continued use of the PCB-laden transformers represents a potential hazard to human health and the environment and possible disruption of the Center's operation from leaks or fire in or near these locations. The latest EPA regulations on PCB transformers under the Toxic Substances Control Act (TSCA), require that all PCB-filled transformers in areas accessible to the public that are greater than 500 ppm be removed from service by October 1, 1990. Some Transformers are being removed for agency safety concerns.

B. Dryden Flight Research Facility (DFRF)..... $1,500,000

1. Remove and Dispose of Asbestos, Building 4800..... 750,000

This project removes water-damaged, spray-applied asbestos insulation from the return-air plenum areas of Building 4800. The areas containing asbestos are the first and second floors of the 1963 addition with a total floor area of approximately 40,000 square feet. This project removes hazardous material from the first floor area (20,000 square feet) which includes fire-proofed beams, ducts, etc., and ceiling tiles. A new lay-in acoustical ceiling will be provided, lighting fixtures replaced where necessary, and damaged architectural finishes repaired as required. Water-damaged insulation containing asbestos in Office Building 4800 contributes to severe environmental hazards from the delamination and release of asbestos fibers within the return air plenum. This project is required to comply with occupational safety and health and environmental standards for occupancy of personnel. Disposal of hazardous wastes will be in accordance with Federal and State EPA-approved regulations.

2. Replace and Dispose of PCB Transformer, Substation No. 16 750,000

This project provides for the replacement and disposal of the 34.4 kV substation #16 transformer which contains 3400 gallons of PCB fluid. The hazardous wastes including the dielectric fluid and contaminated equipment will be disposed of in accordance with current Federal and State EPA regulations. This transformer is presently leaking. Continued use of this 21-year-old transformer represents a potential hazard to human health and the environment.

C. Goddard Space Flight Center (GSFC) $700,000

1. Replace and Dispose of PCB Transformers Serving Bldgs. 3/14 700,000

This project provides for the replacement of two 5,000 KVA, 34.7 KV/4.16 KV, PCB contaminated transformers which have been leaking at the Central Substation, with two 7,500 KVA, non-PCB liquid filled units. Upgrading/replacement of the existing double-ended distribution switchgear and other associated items is also included. Handling and disposal of PCB-contaminated transformer oil, equipment, and other related items shall be in strict compliance with EPA and OSHA regulations. The transformers provide power to mission essential buildings. Also, continued use of these 25 year old transformers represent a potential hazard to health and the environment. The transformers must be replaced to provide the required utility reliabity.

D. Jet Propulsion Laboratory (JPL) $1,020,000

1. Cleanup of Arroyo Seco Groundwater Contamination 500,000

This project will provide for the construction of a treatment facility to remove volatile organic compounds from the groundwater in the Arroyo Seco acquifer. Previous sampling and testing of groundwater from wells in the vicinity of JPL have confirmed the presence of trichloroethylene, carbon tetrachloride, and tetrachloroethylene in excess of Federal and State of California standards. Studies have alleged that JPL operations have contributed to the contamination. A pilot-scale treatment facility using ultraviolet radiation/ozone oxidation was constructed in FY 1987. The data generated by the pilot plant study will be incorporated into this full-scale facility. Once operational, this treatment facility will provide drinking water with volatile organic compound concentrations within the Federal and State of California standards for the residents of San Gabriel Valley.

2. Construction of Hazardous Wastes/Cryogenic Gas Cylinder Storage Facility 520,000

This project provides for the construction of a 4,800 square foot building for the storage and handling of cryogenic materials and hazardous wastes. The facility will be a single story building with

concrete masonry walls, a steel framed fire rated roof system and a loading dock. Currently at JPL, the Propellant Storage Building 116 is used for the storage of cryogenic gas cylinders. The Chemical Storage Building 187 is used for interim storage of a variety of hazardous waste including liquids of a flammable and explosive nature. Both buildings are of wood frame construction, thirty years old, are inadequate in size and do not conform to current Federal or State EPA requirements. The proposed project will provide a safe and adequately sized storage and handling facility for cryogenic materials and hazardous waste materials. Areas allocated for the storage of different categories of cryogenic gas cylinders and hazardous waste materials will be appropriately separated and provided with spillage control and code dictated safety measures. The present inadequate and non-code conforming Buildings 116 and 187 will be demolished.

E. Johnson Space Center (JSC)..... $1,400,000

1. Remove and Dispose of Asbestos, Various Locations..... 300,000

This project provides for the removal and/or encapsulation of damaged asbestos insulation which has been applied to structural steel members and pipes in Buildings 14 and 16 to eliminate or mitigate the source of potential asbestos exposure. This project is required to bring Johnson Space Center buildings into compliance with Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA) regulations which have recently placed more stringent limits on permissible asbestos exposure levels.

2. Replace Hazardous Wastes Storage Systems, Various Locations..... 550,000

This project provides for modifications of the hazardous wastes collection and storage systems which serve the photographic and printing facilities in Buildings 16, 17, and 227 by removing the existing underground rectangular-shaped reinforced concrete tanks and replacing them with new stainless steel tanks placed inside a secondary containment. The secondary containment, a new concrete structure, will be built beneath the ground immediately adjacent to each building. Plumbing connections and replacement of any contaminated soil under the existing concrete tanks is included. This project is required to provide a hazardous waste collection and storage system that is in compliance with current Resource Conservation and Recovery Act (RCRA) regulations for hazardous wastes storage tanks.

3. Replace and Dispose of PCB Transformers (Downey)..... 550,000

This project provides for the replacement of four transformers at the NASA Industrial Plant, Downey, CA. The hazardous wastes, including dielectric fluid and contaminated equipment, will be disposed of in accordance with current EPA regulations. The removed, obsolete, and contaminated equipment will be replaced with equivalent size non-PCB transformers. Continued use of the PCB-laden transformers represents a potential

hazard to human health and the environment and possible disruption of the Center's operation from leaks or fire which is mission critical in the production of the Orbiter.

F. Kennedy Space Center (KSC)..... $2,000,000

1. Cleanup of Wilson Corners Groundwater Contamination..... 200,000

This project provides for the cleanup of contaminants of the surficial aquifer to an acceptable level via the construction and operation of a groundwater/hazardous treatment system/facility. Treatment system/facility is expected to consist of groundwater extraction wells, and a pack-tower aeration treatment unit from which treated effluent will be used for land irrigation. Florida has approved the KSC proposed cleanup methodology and has issued a binding consent order requiring compliance.

2. Cleanup of Orsino Yard PCB Soil Contamination..... 400,000

Orsino Yard was used as a storage area for transformers which had been removed from service in the past before the hazards of PCB-contaminated insulating fluids were known. Because some of these transformers leaked during storage, the soil on the site has been contaminated. Under this project, the soil will be removed, packaged, and properly disposed of in accordance with Federal and Florida EPA Regulations. The project also includes site survey, regrading, and restoring the area back to its natural condition. This remedial action is necessary to ensure compliance with State and Federal EPA regulations.

3. Install Secondary Containment for Hazardous Waste Tanks, Various Locations..... 1,400,000

This project will retrofit approximately 15 existing tanks with a total capacity of over 220,000 gallons to allow treatment to comply with the latest issued EPA regulations governing the design, installation, and use of tank systems for the storage and/or treatment of hazardous waste under the Resource Conservation and Recovery Act (RCRA). The rules require that all new or existing tanks and associated piping have secondary containment with interstitial monitoring. The tanks store hydrazine, nitrogen tetroxide and freon to support critical Space Shuttle facilities such as the Orbiter Processing Facility and Pads A and B of LC-39. Projected flight operations are subject to compliance with the Federal and Florida regulations.

G. Langley Research Center (LaRC) $1,500,000

1. Replace and Dispose of PCB Equipment, Various Locations..... 1,500,000

This project provides for the removal of 50 PCB Transformers serving 26 research facilities. The transformers in the mission essential areas will be replaced or retrofitted with 45 non-PCB transformers which vary from 5 to 2500 KVA. Hazardous wastes, including dielectric fluid and contaminated equipment will be disposed of in accordance with, current regulations. Continued use of the PCB-laden transformer represents a potential hazard to human health and the environment and possible disruption of the Center's operation from leaks or explosion in or near these facilities. Some PCB-filled transformers are leaking and are being replaced for Agency environmental concerns.

H. Lewis Research Center (LeRC).. ..... $3,000,000

1. Replace and Dispose of PCB Transformers, Various Locations..... 3,000,000

This project provides for replacement, disposal and/or retrofill of approximately 80 PCB-filled transformers identified as being contaminated with PCB fluid located at numerous LeRC locations. Equivalent sized non-PCB transformers will be installed to comply with current National Electric Codes. Hazardous wastes including the dielectric fluid and contaminated equipment will be disposed of in accordance with current Federal and State EPA regulations. Many of the transformers are at least 30 years old, and represent a potential hazard to human health and the environment unless they are replaced or retrofilled. The project also includes the modifications necessary to remove the transformers such as wall demolition and the removal and/or relocation of existing cable, conduit and utility services. In locations where new transformers are to be installed, the existing electrical vaults will be rehabilitated, new interface devices and switch gear installed, and new cable routed as necessary. Additionally, some PCB-filled transformers are leaking and must be replaced due to Agency environmental concerns.

I. Marshall Space Flight Center (MSFC)..... ..... $3,575,000

1. Remove and Dispose of Asbestos, Building 4202..... 2,900,000

The project is to remove friable asbestos-containing materials from Building 4202. The asbestos is in the form of spray-applied insulation (SAI), pipe insulation, and ceiling plaster. The SAI is located throughout the building above the ceiling, in the basement, and on the exterior wall structural steel. The asbestos fibers are released spontaneously from asbestos-containing material in the normal process of aging and deterioration. Deterioration is increased by external forces such as air currents, physical damage and building vibration. Significant short-term exposure level is obtained when the asbestos fireproofing material is physically disturbed. The fibers, which may be released can remain suspended for a considerable period of

time (80 hours is not uncommon), which increases office and maintenance personnel exposure to airborne asbestos fibers. These fibers, once released, are recirculated throughout the building via the return air duct and supply duct. Normal housekeeping procedures do not effectively remove asbestos fibers from the area. These asbestos-containing materials are to be removed from approximately 85,500 square feet in Building 4202 so that a potential employee health hazard risk is eliminated from the work environment. The asbestos material will be replaced with a suitable insulation to provide fire-proofing to the building structure. The work area of Building 4202 will be restored to its original condition after removal and replacement of the asbestos insulation.

2. Remove and Dispose of Asbestos, Building 902 (SCC)..... 675,000

This project provides for the removal of asbestos containiing materials from the first floor of Building 902 at Slidell Computer Complex. Work will consist of removal of spray-applied asbestos insulation above the ceiling and asbestos acoustical materials on the walls. It shall also include air monitoring during the asbestos material removal. The asbestos material will be replaced with a suitable insulation to provide fireproofing to the building structure. The area shall also be restored to its original condition after removal and replacement of the asbestos materials. It shall also include the installation of free standing, floor mounted air conditioning units with piping and electrical wiring for environmental control and an underfloor water alert system.

J. Michoud Assembly Facility (MAF)..... $2,000,000

1. Closure and Decontamination of Surface Impoundments..... 2,000,000

This project provides for the closure and decontamination of the two hazardous waste surface impoundments. The work includes removal and disposal of all residual wastes, decontamination of the synthetic liners and concrete liners of the tanks, and removal and disposal of any contaminated soil. The project complies with the Resource Conservation and Recovery Act (RCRA) which requires closure and decontamination of any hazardous waste facility that is no longer operational.

K. Wallops Flight Facility (WFF)..... $300,000

1. Construction of Hazardous Materials Storage Facility..... 300,000

This project provides for construction of a 3,000 square foot building for storing hazardous materials at Wallops. The building features will include poured concrete exterior walls, an interior floor sloped to a collection sump, electrical system; adjustable ventilators system, dry pipe sprinkler system and a 500 square foot exterior pad for cyclinder storage. Currently, hazardous materials such as alcohol, methylethylketone, haloginated solvents, paints, and paint thinners are stored at various locations throughout Wallops Flight

Facility. Undetected spills have the potential of contaminating the existing facility groundwater system and surrounding areas. This building would eliminate this environmental concern and provide a safe, isolated area for storage and collection.

L. White Sands Test Facility (WSTF).. ..... $3,500,000

1. Groundwater Contamination Assessment..... 2,500,000

This effort is to define the extent, impacts, and possible remediation approaches for groundwater and soil contamination existing at WSTF and affected offsite areas. This includes installation of the groundwater monitoring well networks associated with the closure of the 200-, 300-. 400-, and 600-area hazardous waste management units. The majority of the work will consist of the installation of monitoring wells as required to define the horizontal and vertical contamination characteristics of the groundwater and to track future changes. Also included in the package are related soil gas and seismic surveys, data analysis, and engineering/chemical analyses needed to assure proper placement of wells and validity of sample results. It is possible that the results of current survey efforts will indicate that further contamination surveys are required, but these efforts cannot be quantified at this time.

2. Consolidation of Laboratories for Environmental Compliance..... 1,000,000

The consolidation of the hazardous waste generating operations and functions of the White Sands Test Facility (WSTF) laboratories is required to obtain a facility operating permit (Part B Permit) which must be issued by 1990 as required by the Resource Conservation and Recovery Act. Existing laboratory facilities and operations are inadequate to meet the requirements for this permit. This project will provide for the installation of new double wall drains as required to meet regulatory compliance schedule for approval of WSTF facility operating permit. Also, the existing fuel scrubber will be replaced and the oxidizer fume exhaust system will be upgraded.

M. Various Locations..... $1,200,000

1. Upgrade Solid Waste Disposal System, Various Locations, Goldstone, CA..... 500,000

This project at the Goldstone Deep Space Communications Complex provides for modifications of solid wastes disposal facilities at Echo site (DSS-12) and closure of solid wastes disposal facilities at the Mojave site. At the Echo site, the landfill site now in use will be enlarged to 20 acres, graded, and fenced. This landfill and the old closed landfill areas will be equipped with groundwater monitoring and shallow wells. At the Mojave site, contaminated soil and materials in disposal areas and trenches will be excavated. Non-biodegradable materials will be removed to an approved disposal site. Excavated areas will be backfilled and graded. After installation of groundwater monitoring and vadose wells, the Mojave solid waste disposal area

will be closed. This project is required for achieving compliance with California Regional Water Quality Control Board (CRWQCB), California Administrative Code (CAD) Title 14, National Resources Division 7 and Title 23, Subchapter 15, Chapter 3, regulations for landfill areas including security, monitoring, reporting, and closure requirements.

2. Install Hazardous Wastes Storage Areas, Various Locations, Goldstone, CA..... 200,000

This project at the Goldstone Deep Space Communications Complex provides for the modification of existing hazardous wastes storage areas and the construction of two new open-sided and roofed-over hazardous materials storage sheds at Mars site (DSS-14) and Apollo site (DSS-12). Included is the removal and replacement of contaminated soils, asphalt, and other paving materials. The new storage facilities will be equipped with safety showers, fire extinguishers, safety eyewash facilities, forklift access and curbed concrete floors without drains. This project is required to achieve compliance with California Administrative Code (CAC) Title 19, 22 (Art. 4,6,7, 18,20,24,25) and 23. These regulations for the storage of applicable hazardous and contaminated materials require roofed-over type storage areas with suitable personnel safety, spill, and fire control provisions.

3. Air Quality Control, Goldstone, CA..... 500,000

This project at the Goldstone Deep Space Communications Complex provides for the construction and installation of engine exhaust airborne particle arrestors at power plants. Arrestors will be installed on each of the engines in the Echo (DSS-12) and Mars (DSS-14) station power plants. In addition, this project provides for modifications to correct venting of enclosed solvent storage areas, paint spray booths, and paint storage areas, and for construction of approved sandblasting areas. This project is required for achieving compliance with the Federal Clean Air Act of 1977, 40 CFR, Part 60, and with the San Bernardino County Air Pollution Control District Rules and California Administrative Code (CAC) Title 19 and 22, which require the reduction of airborne particulate matter to ten microns or smaller (to reduce photochemical smog). The work includes analysis of exhaust and vent discharges to verify compliance.

MISCELLANEOUS PROJECTS LESS THAN $150,000 EACH..... $795,000

STUDIES, ASSESSMENTS, AND DESIGNS..... $2,110,000

FUTURE CoF FUNDING REQUIRED TO COMPLETE THIS PROJECT:

An estimated $30,000,000 per year for the next several years will be required for continuing Environmental Restoration and Compliance.